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PREIMPOUNDMENT STUDY, CARTERS LAKE

Environmental Protection Agency
Athens, Georgia

March 1972

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PREIMPOUNDMENT STUDY

CARTERS LAKE

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Technical Study Report
TS 03-71-208-001.4

Environmental Protection Agency
Region IV
Surveillance and Analysis Division
Athens, Georgia

March 1972

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INTRODUCTION

In October 1967, the Mobile District, Corps of Engineers requested the Southeast Region, Federal Water Pollution Control Administration to make a preimpoundment water quality study of the Coosawattee River at the Carters damsite (Appendix A). Personnel from FWPCA's Southeast Water Laboratory (now part of the Environmental Protection Agency) conducted the studies needed to answer this request. Authorization for such a study lies in Section 5c of the Federal Water Pollution Control Act (PL 84-660) as amended by PL 87-80, PL 89-234, PL 89-753, and PL 91-224.

SUMMARY

The Carters Lake preimpoundment study, conducted over three years to account for annual water quality variations, showed:

- Water temperatures in the study area reanged from 12.5°C to 26°C.
- pH remained within 0.5 units of neutrality.
- Hardness, dissolved solids, and alkalinity are all low.
- Turbidity exceeded 25 Jackson Turbidity Units only during storm runoff. Sediment loads were low in the watershed.
- Color was low; average values ranged from 10 to 30 platinum cobalt units.
- Dissolved oxygen ranged from 8.0 mg/1 to 11.8 mg/1 during spring and 6.6 to 9.9 mg/1 during summer. Dissolved oxygen saturations ranged from 76 to greater than 100 per cent for both seasons.
- The City of Ellijay, Georgia, discharged approximately 1 MGD of untreated domestic and industrial wastes to the Coosawattee River and its tributaries.*
- BOD_5 averaged less than 2.0 mg/1 except immediately downstream from Ellijay where it ranged from 2.1 to 8.8 during summer.*
- Significant nitrogen (2.23 mg/1 summer average - Total N) and phosphorus (0.19 mg/1 summer average - Total P) concentrations were found downstream from Ellijay, but no excessive algal

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* Since the time this report was first drafted the City of Ellijay has completed and is now operating a secondary (activated sludge) waste treatment plant with post-chlorination that is treating all municipal and industrial wastes in the area.

growth was observed. Less significant but still noticeable concentrations (1.07 mg/l Total N and 0.02 mg/l Total P) in Talking Rock Creek were caused by farmland runoff. The nitrogen and phosphorus levels at mainstem stations near the dam were low.*

- Average iron and manganese concentrations in the water samples were less than 1.6 and 0.12 mg/l total Fe and Mn, respectively.
- High mean fecal coliform concentrations (76,000/100 ml) were present immediately downstream from Ellijay in the Coosawattee River.* The remaining drainage area was relatively free from major bacterial pollution.
- Benthic Biota indicated excessive organic enrichment immediately downstream from Georgia Broilers; all other areas examined were "biologically" healthy.*
- Water quality standards have not been established for the Coosawattee River, an intrastate stream. However, the reservoir will probably be classified for recreation and the river from below the dam to the confluence with the Conasauga will probably be for fishing.

---

* Secondary treatment now installed. See footnote on page 2.

CONCLUSIONS

- With some local exeptions, the waters to be impounded for Carters Lake are of good quality.
- Secondary treatment and chlorination of municipal and industrial wastes from Ellijay coupled with accelerated bacterial die off associated with impoundment should permit full use of Carters Lake as a desirable recreational area.*
- Thermal stratification in this unusually deep reservoir will cause depressed dissolved oxygen levels and possible increases in dissolved iron and manganese in the hypolimnion. Downstream water quality (DO, iron, manganese, odors) could be adversely affected by hypolimnetic discharges. Effects of pumped storage on quality of release waters and reservoir stratification are not known in this specific case, but are expected to be beneficial.
- The current potential for occurrence of nuisance biological problems associated with reservoir eutrophication is low, but development of the watershed and reservoir periphery could increase the possibility of accelerated eutrophication.

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* Secondary treatment now installed. See footnote on page 2.

RECOMMENDATIONS

- A program for water quality management in the Carters Lake drainage basin should be established by responsible agencies prior to any increase in commercial, industrial, residential, or other waste-generating development. Regulations pertaining to sanitation within the reservoir proper would be a part of the program and should include prohibiting the discharge of wastes from watercraft.
- Studies should be initiated as soon as possible following impoundment to determine if stratification is eliminated through pumped storage or whether water quality problems will occur downstream from the dam. If water quality problems occur, remedial measures must be taken to protect the high quality which now exists at the dam site.
- Any water supply intakes built within the reservoir should be designed to withdraw water selectively from different water levels to permit the use of best quality waters in the event stratification 1/ occurs.

1/ With information from postimpoundment studies, this recommendation could be modified or eliminated altogether.

DESCRIPTION OF PROJECT AND PROJECT AREA

CARTERS DAM & LAKE

The Carters Lake project is on the Coosawattee River about 60 miles north of Atlanta in Gilmer and Murray Counties, Georgia (Fig. 1). The project includes a main dam and a re-regulation dam, both of which will create reservoirs. The main impoundment is primarily for flood control but will also be used for hydroelectric power generation and recreation. The re-regulation dam will regulate peaking power releases from the main dam plus flows from Talking Rock Creek.

The main dam is rock and earth fill, 1950 feet long and 447 feet above natural ground level. Total storage capacity from 376 square miles of drainage includes:

- Dead storage 183,500 acre feet
- Power storage 193,600 acre feet
- Flood storage 96,000 acre feet.

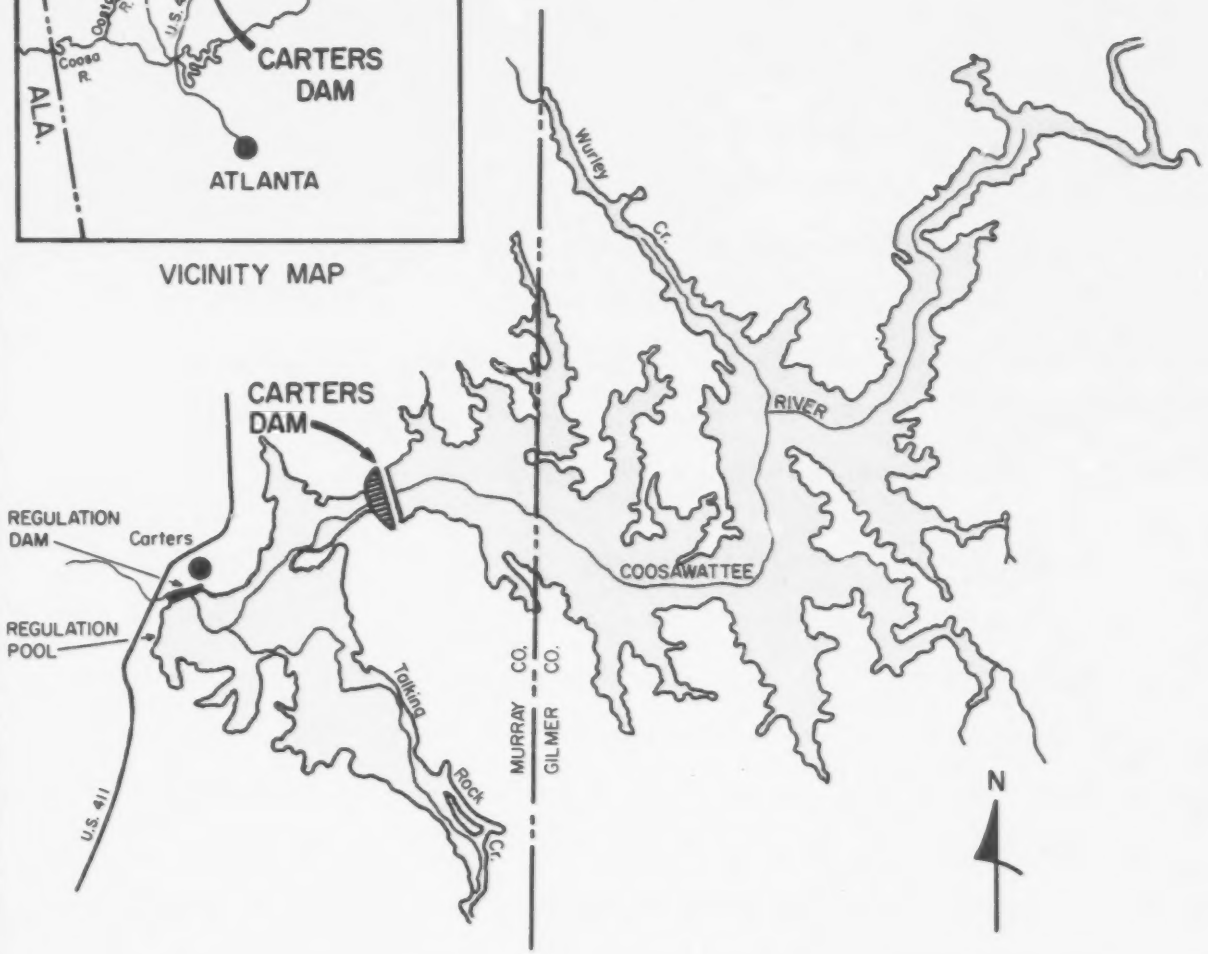
An additional induced surcharge storage of 31,800 acre-feet is available to partially regulate floods or combinations of floods greater than the 100 year flood.

At maximum power pool elevation (1072 feet above mean sea level), the primary reservoir will cover 3,220 acres; at flood storage elevation (1099 feet above mean sea level), 3880 acres will be covered.

The re-regulation dam is a 2090-foot long protected earth dike; its top elevation is 701 feet above mean sea level. It drains 530 square miles (including that of the main dam). It will have a maximum pool at 688.7 feet and a minimum pool at 665.5. At maximum pool level, the reservoir will cover 630 acres and have a storage of 9400 acre-feet of which

FIGURE 1

VICINITY MAP



SCALE IN FEET

2,000 0 4,000 8,000

SOUTHEAST WATER LABORATORY
ATHENS GEORGIA

CARTERS DAM
GENERAL LOCATION MAP

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

9200 acre-feet will be available for flow regulation between the maximum and minimum pool elevations. The re-regulation pool will also provide the water for the reverse pumping operation.

Flood control benefits extend principally to downstream rural farm areas with minor benefits to the towns of Calhoun and Rome, Georgia. Little or no flooding is expected just below the dams on the Coosawattee, but infrequent overflows may occur on high yield farmland further downstream. Flood stages will be reduced 5 to 6 feet for medium-sized floods along the lower reach of the river.

Recreation benefits will be provided for more than 1.5 million people living within 75 miles. The Corps of Engineers estimates that 1.25 million people will use the reservoir annually.

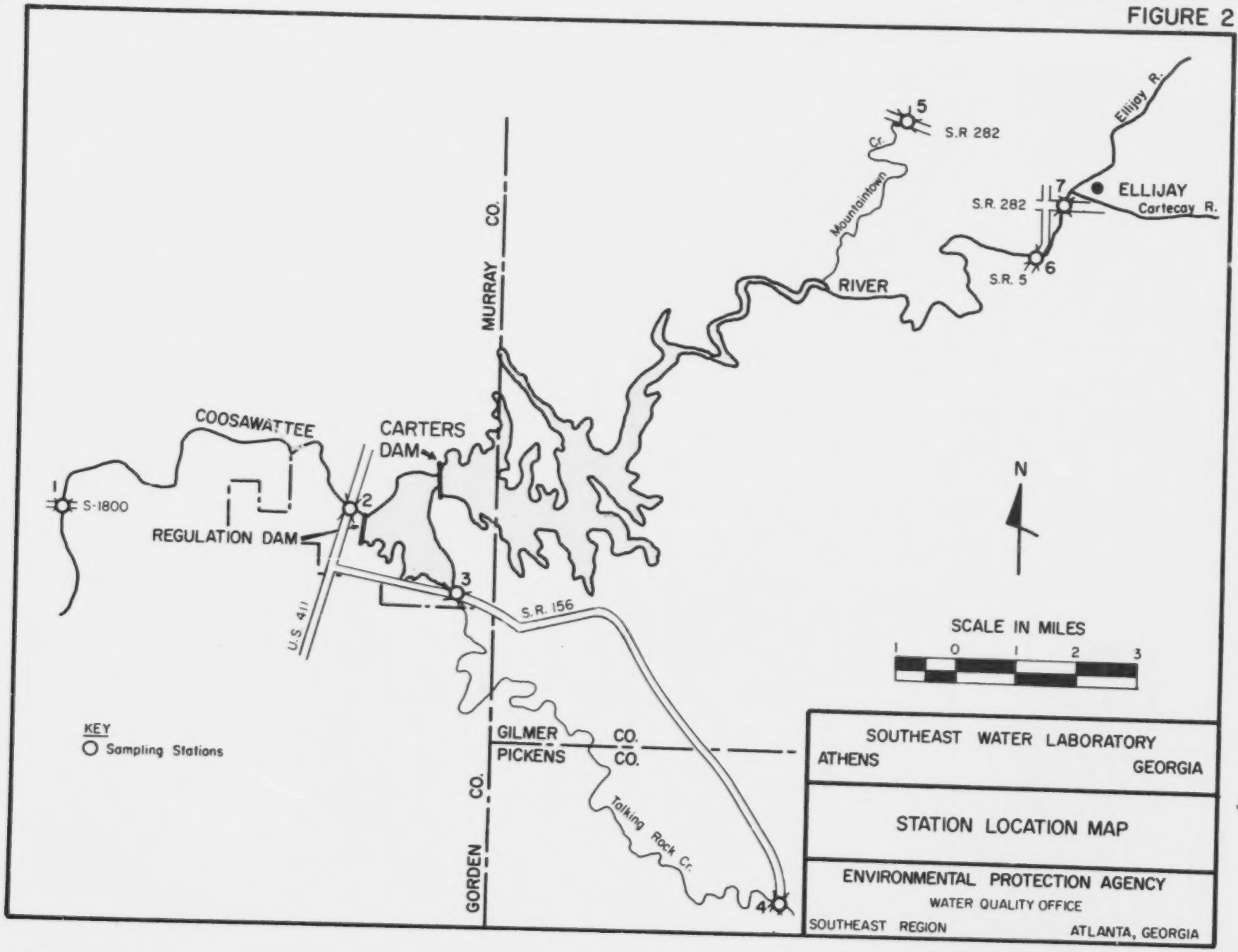
COOSAWATTEE RIVER WATERSHED - PHYSICAL AND HYDROLOGIC CHARACTERISTICS

The Coosawattee River begins at the confluence of the Ellijay and Cartecay Rivers in the Blue Ridge Mountains of Gilmer County, Georgia (Fig. 2). The one major tributary upstream from the dam is Mountaintown Creek. Downstream from the dam, the Coosawattee flows southwesterly and combines with the Conasauga to become the Oostanaula River.

Throughout the watershed, stream banks are covered with heavy foliage. At some locations, decaying vegetation (primarily trees) has fallen into the water.

The drainage basin is 90% woodland with the remaining for farm and residential use. Ellijay, Georgia, is the only municipality. Additional control of wastes within the watershed would be difficult because of scattered resident population and pastureland drainage.

FIGURE 2


5
S.R 282
Ellijay R.
Cr.
Mountaintown
7
ELLIJAY
Cartecay R.
S.R. 282
6
S.R. 5
RIVER
MURRAY CO.
COOSAWATTEE
CARTERS DAM
1
S-1800
2
REGULATION DAM
3
S.R. 156
U.S. 411
N
SCALE IN MILES
1 0 1 2 3
KEY
Sampling Stations
GILMER CO.
PICKENS CO.
GORDEN CO.
Talking Rock Cr.
4
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
STATION LOCATION MAP
ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

River beds consist of alluvial deposits which during the storm runoff are resuspended and can cause high sediment loads. Severe erosion is limited by the large percentage of woodland. During reservoir construction and initial filling, erosion will be a short-term problem. The reservoir is being completely cleared only between elevations 1000 and 1075 feet above mean sea level. Modified clearing to prevent trees from extending above the 1015 contour will be performed. When reservoirs are not cleared, decaying organic matter may produce noticeable taste, odor, and color problems. With time, decay of inundated vegetation will cease and only the external introduction and within-reservoir generation of organic matter will affect water quality. Flooded timber may eventually break loose, and initially, quantities of it will float to the surface creating hazards to boaters and water skiers. These materials will tend to accumulate and form costly nuisances at bar screens of the dam's discharge point. This flotsum should be handled from the reservoir and disposed of in a manner to meet state and local pollution control ordinances.

The Corps of Engineers has long-term flow records for the Coosawattee River at the dam site. For 26 years of record, the average discharge is 740 cfs. Flow extremes at the dam site range from 200 cfs to 26,700 cfs. The re-regulation dam will regulate the main dam's power releases and Talking Rock Creek discharges, and thereby reduce damage from high or low flows.

STUDY METHODS

FIELD SAMPLING PROGRAM

Final selection of seven sampling stations was made during a pre-survey reconnaissance immediately preceding the 1968 spring survey (Fig. 2). Three stations coincide with those sampled by FWPCA in 1966. Site descriptions are in Appendix B.

Two sampling periods were established:

- Spring - April 4-9, 1968 to determine water quality during cool weather and high runoff.
- Summer - July 9-11, 1968; September 16, 1968; July 16, 1969; and July 9, 1970 to determine water quality at various times during hot weather and low runoff.

Desired sampling conditions were met in that the spring survey streamflows exceeded the average annual flow of approximately 1270 cfs, and summer flows were less (Fig. 3). During the spring and summer survey of 1968, rainfall measured more than 2 1/2 inches and 1/2 inch respectively (Table 1). Sample analysis results are representative of normal annual water quality variations within the drainage basin.

Grab sampling techniques (one sample per day) were used during the surveys. During the 1968 spring and summer surveys, sampling time at each station was varied to account for diurnal fluctuations.

PHYSICAL AND CHEMICAL WATER QUALITY

Table 2 shows the type and method of analyses for the various physical and chemical constituents measured.

FIGURE 3

STREAM FLOWS DURING SURVEY PERIODS
U.S.G.S. GAGE 3835
CARTERS, GEORGIA

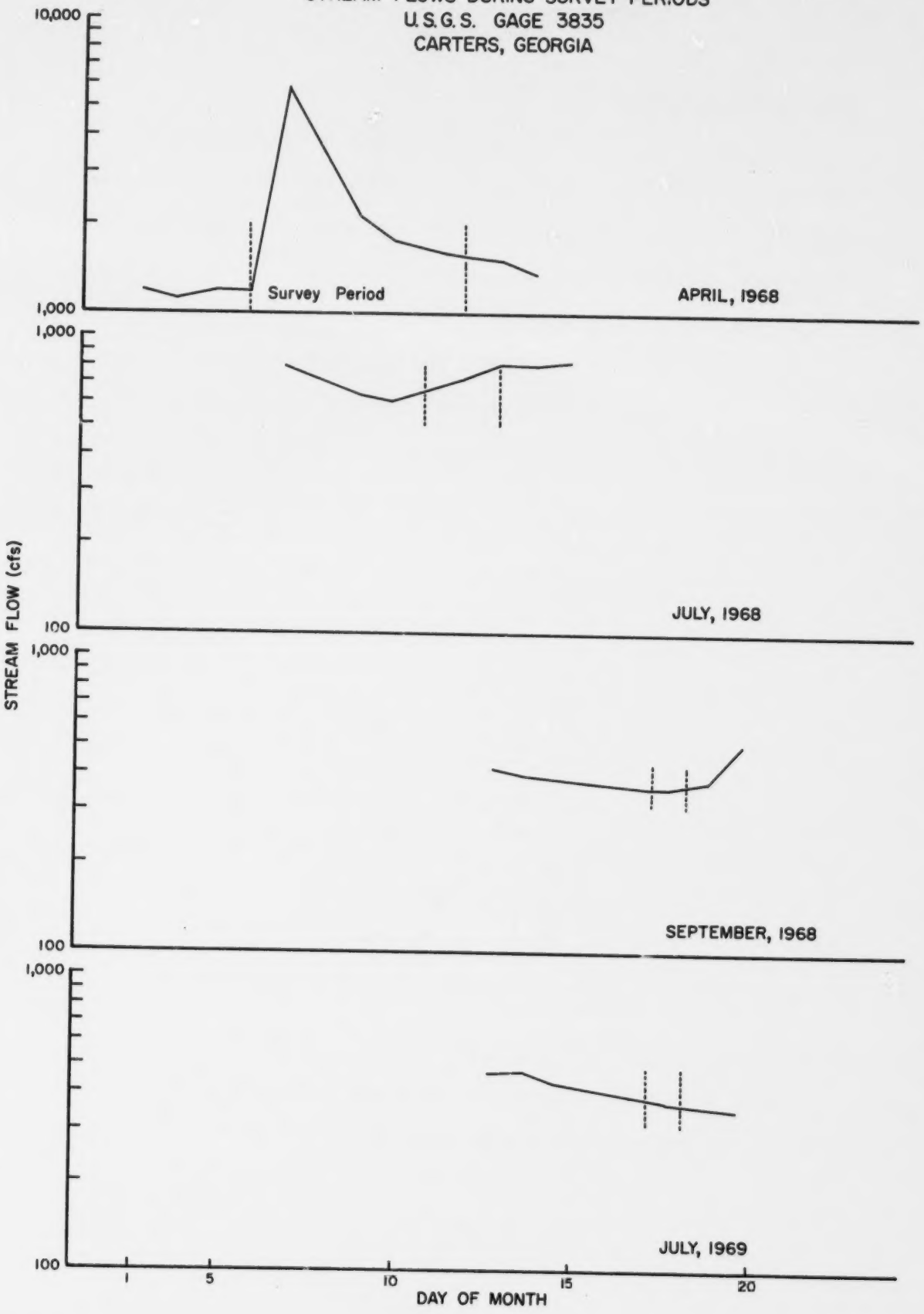


TABLE 1

RAINFALL - AIR TEMPERATURE DATA

Date	Rainfall* (Inches)	Average Air Temperature (°F)
April 1, 1968	0.28	63
April 2, 1968	0	53
April 3, 1968	0	51
April 4, 1968	0	65
April 5, 1968	2.5	55
April 6, 1968	0	52
April 7, 1968	0	55
April 8, 1968	0	58
April 9, 1968	0.02	62
July 4, 1968	0.17	73
July 5, 1968	0.06	71
July 6, 1968	0	78
July 7, 1968	0	74
July 8, 1968	0	75
July 9, 1968	0.41	71
July 10, 1968	0	74
July 11, 1968	0.26	76
September 14, 1968	0	65
September 15, 1968	0	66
September 16, 1968	0	70
July 13, 1969	0.15	81
July 14, 1969	0	82
July 15, 1969	0	79
July 16, 1969	0	81
July 7, 1970	0	72
July 8, 1970	0	74
July 9, 1970	0.08	77

* Rainfall from Carters, Ga.; temperature from Calhoun Experiment Station, U. S. Department of Commerce NOAA Environmental Data Service, Climatological Data.

- Survey Period.

TABLE 2
PHYSICAL AND CHEMICAL ANALYSES AND METHODS

Type Analysis	Measurement Method	Where Measured
Temperature	Bimetallic thermometer	Sampling site
pH	Line-operated meter	Field lab
Turbidity	Hellige turbidimeter	Field lab
Color	Standard Methods*	Field lab
Conductivity	Line-operated meter	Field lab
Dissolved oxygen (DO)	Standard Methods (azide modifications)*	Field lab
Biochemical oxygen demand (BOD)	Standard Methods	Field lab
Total hardness	Standard Methods	Field lab
Total alkalinity	Standard Methods	Field lab
Iron	Atomic absorption spectrophotometer**	Southeast Water Lab
Manganese	Atomic absorption spectrophotometer	Southeast Water Lab
Total Kjeldahl nitrogen	Technicon AutoAnalyzer technique	Southeast Water Lab
Nitrate-Nitrate	Technicon AutoAnalyzer technique	Southeast Water Lab
Ammonia	Technicon AutoAnalyzer technique	Southeast Water Lab
Total phosphate	Technicon AutoAnalyzer technique	Southeast Water Lab
Dissolved phosphate	Technicon AutoAnalyzer technique	Southeast Water Lab

*Standard Methods for the Examination of Water and Wastewater, Twelfth Edition, 1965. (1)

**FWPCA Methods for Chemical Analysis of Water and Wastes. (2)

BACTERIAL QUALITY

Surface samples were collected at each of the sites shown on Figure 2. All samples were collected using the grab technique. Samples were collected at midstream unless waste source information warranted left and/or right bank collection.

All samples were preserved in ice for analysis. Most analyses were initiated within five hours after collection.

Total coliform analyses were made using the standard membrane filter procedure as outlined in Standard Methods. (1) This procedure uses M-Endo Broth with an incubation temperature of $35^{\circ} \pm 0.5^{\circ}C$ for 24 ± 2 hours.

Fecal coliform analyses were made using the procedure of Geldreich, et. al. (3) This procedure employs M-FC Broth with an incubation temperature of $44.5^{\circ} \pm 0.5^{\circ}C$ for 22 ± 2 hours.

BIOLOGICAL QUALITY

Biological sampling was conducted only during April 1968. Stations 1-6 consisted of transects approximately 150 feet wide. A poultry processing plant (Georgia Broilers) located on the left bank near Station 7 dictated the need to collect biological material from each riverbank.*

Invertebrates were collected from submerged aquatic vegetation and streambed detritus with a modified crabnet (38 mesh Ward net). Additional organisms were hand-picked with forceps from submerged logs, boards, and rocks. The organisms were separated from debris and preserved in labeled vials containing 70 percent alcohol for specific laboratory identification.

To assist in the interpretation of biological findings, each organsism was categorized accoridng to the Biotic Index. The Index number

* Secondary treatment now installed. See footnote on page 2.

is derived in two steps. First, the species of organisms that tolerate no appreciable organic pollution (Class I), and then the species that tolerate moderate organic pollution, but cannot exist under near-anaerobic conditions, (Class II) are determined. Second, the Biotic Index is determined from the formula:

$$2(n \text{ Class I}) + (n \text{ Class II}) = \text{Biotic Index}$$

where (n) is the number of species. Index values vary from 0 to 60; values in clean streams range from 10 to 60; a grossly polluted stream has an Index value of 0; and moderately polluted stream, 1 to 9.

STUDY FINDINGS

PREVIOUS STUDY INFORMATION

During field investigations conducted by FWPCA in 1966, some water quality data were obtained from Stations 2, 3 and 6. These data (Appendix C) reflect analyses on grab samples made in July and August. Coosawattee River flow at U. S. 411 averaged 720 cfs. Water temperature ranged from 21 to 24°C, and the dissolved oxygen saturation generally exceeded 90%. BOD_5 averaged 3.3 mg/l at Station 6 and 1.4 mg/l at Station 2. The pH averaged within 0.5 units of neutrality. Total alkalinity averaged 17 mg/l. These earlier findings fully support results of the 1968-70 studies.

WASTE SOURCES

The only significant sources of municipal and industrial waste within the watershed is the City of Ellijay (0.2 MGD), Georgia Broilers (0.75 MGD), two rug mills and one hosiery mill (0.3 MGD), and a few other smaller industries, all of which had no treatment facilities at the time of the surveys. A secondary treatment (activated sludge) plant with chlorination, which will treat all wastes, is under construction and expected to be completed by November, 1971; this plant will treat all these wastes.*

Minor sources of waste include cropland and livestock grazing area runoff and domestic wastes from rural homes.

WATER QUALITY STANDARDS

Water quality standards have not been established for the Coosawattee River, an intrastate stream. However, the lake will

* Secondary treatment now installed. See footnote on page 2.

probably be classified for recreation and the river from the dam to its confluence with the Conasauga will probably be classified for fishing. Criteria for these proposed standards have been developed; however, the standards have not been approved.

SPRING & SUMMER SURVEYS 1968-1969-1970

The spring and summer surveys are discussed together. Average, maximum, and minimum values for the various water quality parameters are in Appendix D.

Physical and Chemical Quality

During both cool and warm weather, the pH was within 0.5 units of neutrality. In April, the average for all station was 7.0; in the summer surveys it was 7.2. Neutral range pH values during warm weather indicate that algal production (usually associated with a much higher pH than 7.2) was minimal.

Water temperatures ranged from 12.5° to 15.5°C in April and from 17.5° to 26°C* during the summer months. Water of all stations had little temperature variation during the surveys even though summer data were collected over three years.

Turbidity reflected stream sediment loads at the time of sampling. During the second day of the spring survey, a 2 1/2-inch rainfall caused the turbidity to exceed 200 (Jackson Turbidity Units) at all but Station 4 (91 units). The next day the turbidity was less than 25 at all stations. Study area streams have a high capacity for turbidity reduction after runoff ceases.

A half inch rain during the 1968 summer survey caused the turbidity to exceed 25 at Station 4 (36 units), 6 (49 units), and 7 (100 units).

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* From July-August 1966 data.

No turbidity values over 25 were reported in 1969 and 1970. Turbidity values for the entire survey reflected bodies of water with low sediment load and little algal activity.

Color values were generally low and similar at all stations with averages from 10 to 30 (platinum-cobalt units) for both survey seasons.

Specific Conductance, Hardness and Alkalinity

Specific Conductance, an indication of dissolved solids content, was low at all stations during both cool and warm weather surveys. April averages ranged from 17 to 44 micromhos (μmho) while summer averages were from 19 to 64. Talking Rock Creek consistently had the highest readings.

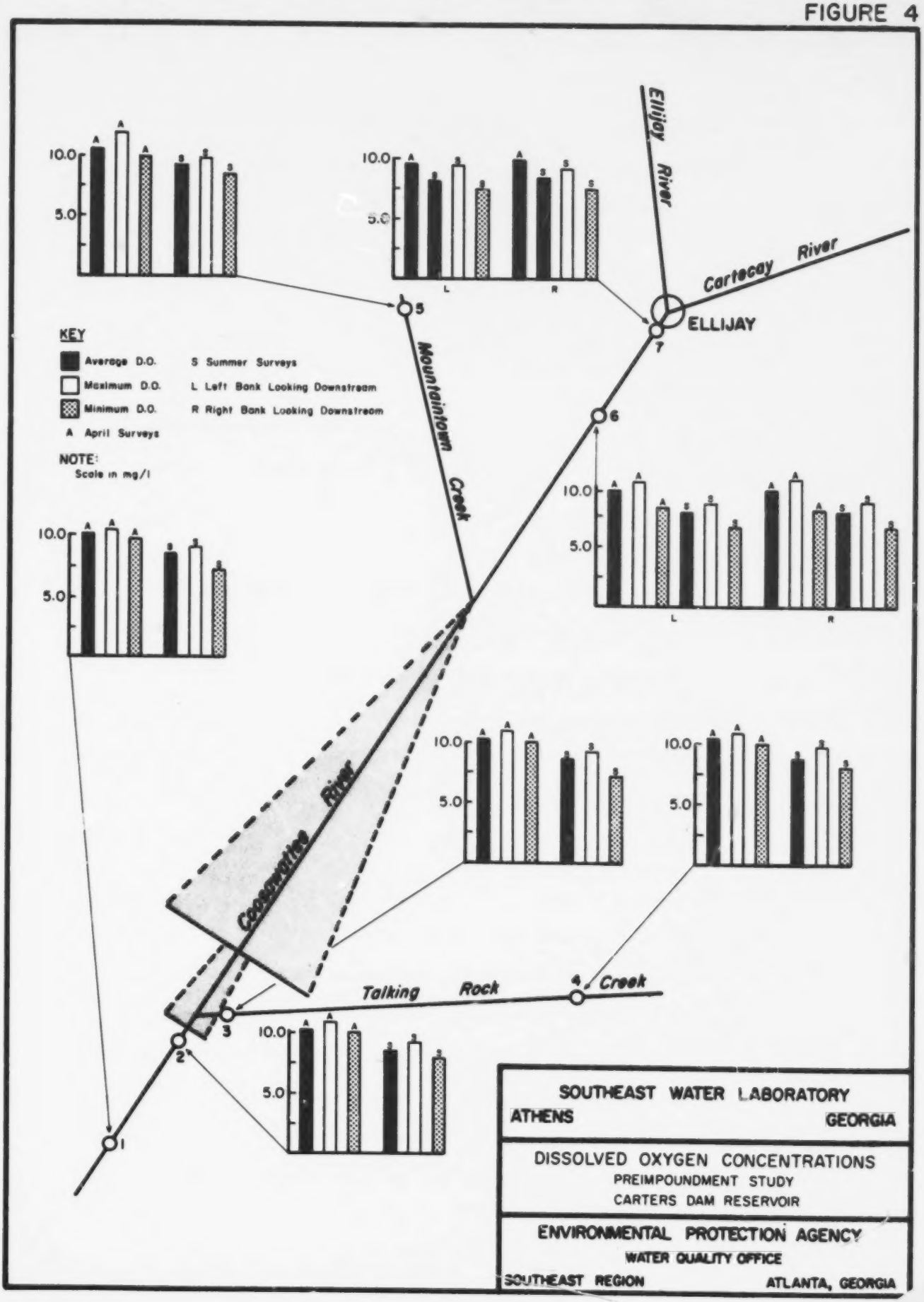
Hardness analyses revealed very soft waters in the Carter's Dam drainage area. During all surveys, upper main stem stations averaged about 10 mg/l (as $CaCO_3$). At Stations 1 and 2, the average was about 15 mg/l.

Alkalinity was low at all stations at all times. Only in Talking Rock Creek did the concentration reach as high as 30 mg/l (as $CaCO_3$).

DO and BOD_5

There were no low DO problems at any time (Figure 4); DO saturations ranged from 76 percent greater than 100 percent.

Georgia Broilers' untreated poultry processing wastes caused a noticeable increase in BOD_5 concentration immediately downstream at Station 7-L (summer 8.6 mg/l; spring 4.1 mg/l). Because the wastes were not well-mixed in the river at Station 7, the right bank BOD_5 (7-R) reflected background conditions only. One mile downstream from the poultry processing plant, at Stations 6-L and 6-R, slightly lower DO


Ellijay River
Cartecay River
ELLIJAY
Mountaintown Creek
Coosawattee River
Talking Rock Creek
KEY
Average D.O.
Maximum D.O.
Minimum D.O.
A April Surveys
S Summer Surveys
L Left Bank Looking Downstream
R Right Bank Looking Downstream
NOTE:
Scale in mg/l
10.0
5.0
1
2
3
4
5
6
7
SOUTHEAST WATER LABORATORY
ATHENS GEORGIA
DISSOLVED OXYGEN CONCENTRATIONS
PREIMPOUNDMENT STUDY
CARTERS DAM RESERVOIR
ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

and BOD_5 concentrations reflected some effect of Ellijay area waste discharges on stream assimilative capacity. With treatment, water quality deterioration caused by this point source will be eliminated.*

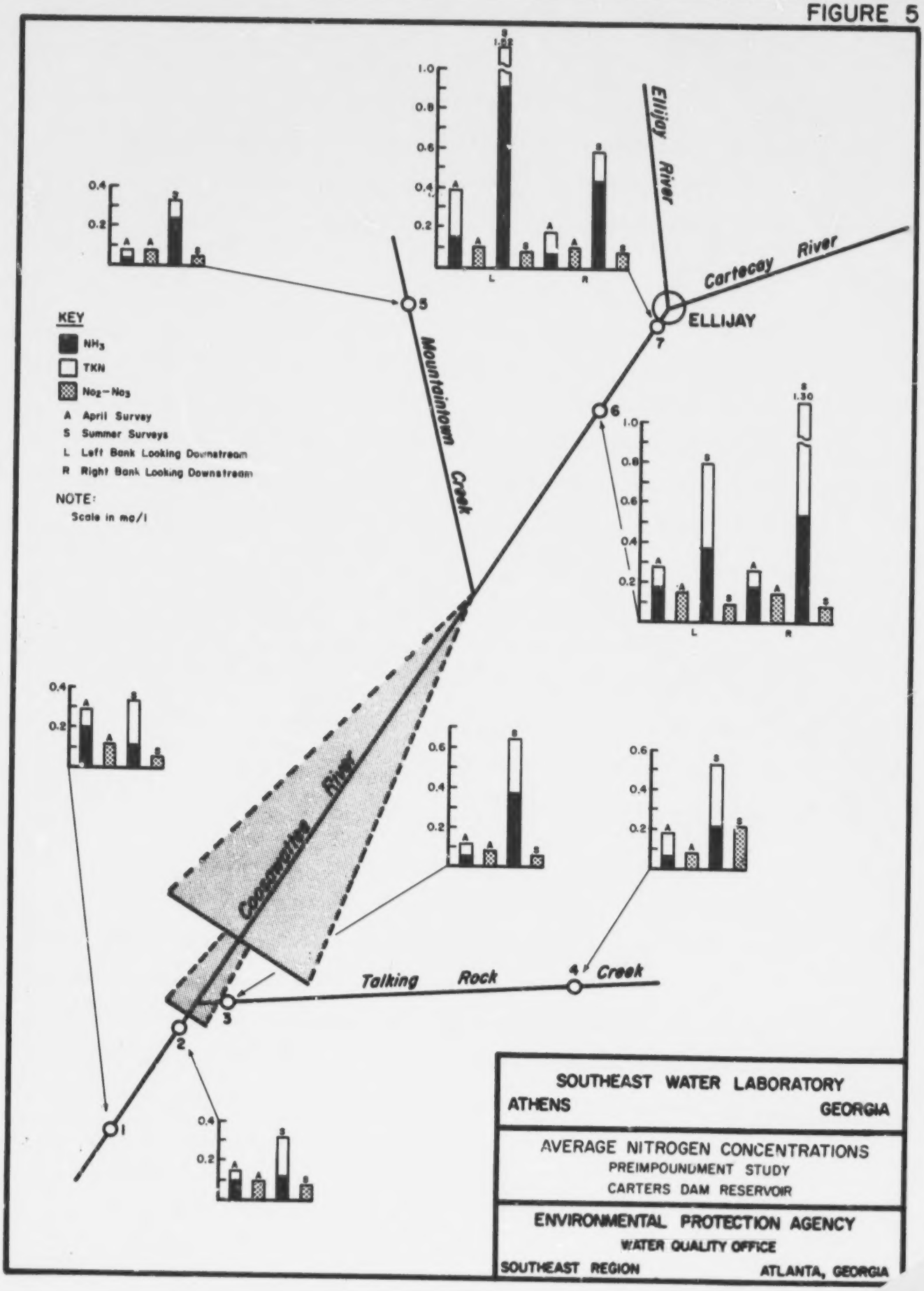
Nitrogen and Phosphorus

Wastes from Georgia Broilers and the City of Ellijay caused nitrgen and phosphate concentration increases at Stations 6 and 7 (Figures 5 and 6).* However, in view of the expected nitrogen and phosphorus reductions through waste treatment and downstream dilution, future water quality problems from this source are not anticipated in the impoundment. Background concentrations approximate those found at Station 5 -- a control station with no upstream pollution. The slight concentration increases at Station 3 and 4 were probably caused by farm and grazing land runoff. Concentrations at Stations 1 and 2 are low. Higher concentrations of phosphate as P in the spring were probably caused by higher runoff.

Iron and Manganese

Average iron and manganese concentrations were higher during the spring survey because of high runoff (Figures 7 and 8). Respective concentrations up to 1.63 and 0.12 mg/l were observed in April 1968. Iron was predominantly in particulate form and manganese was about 50% particulate. These levels are far above the Public Health Service drinking water standards of 0.3 mg/l for iron and 0.05 mg/l for manganese. As the reservoir fills and these ions precipitate to the bottom, they will be reduced. Excessive concentrations of both iron and manganese

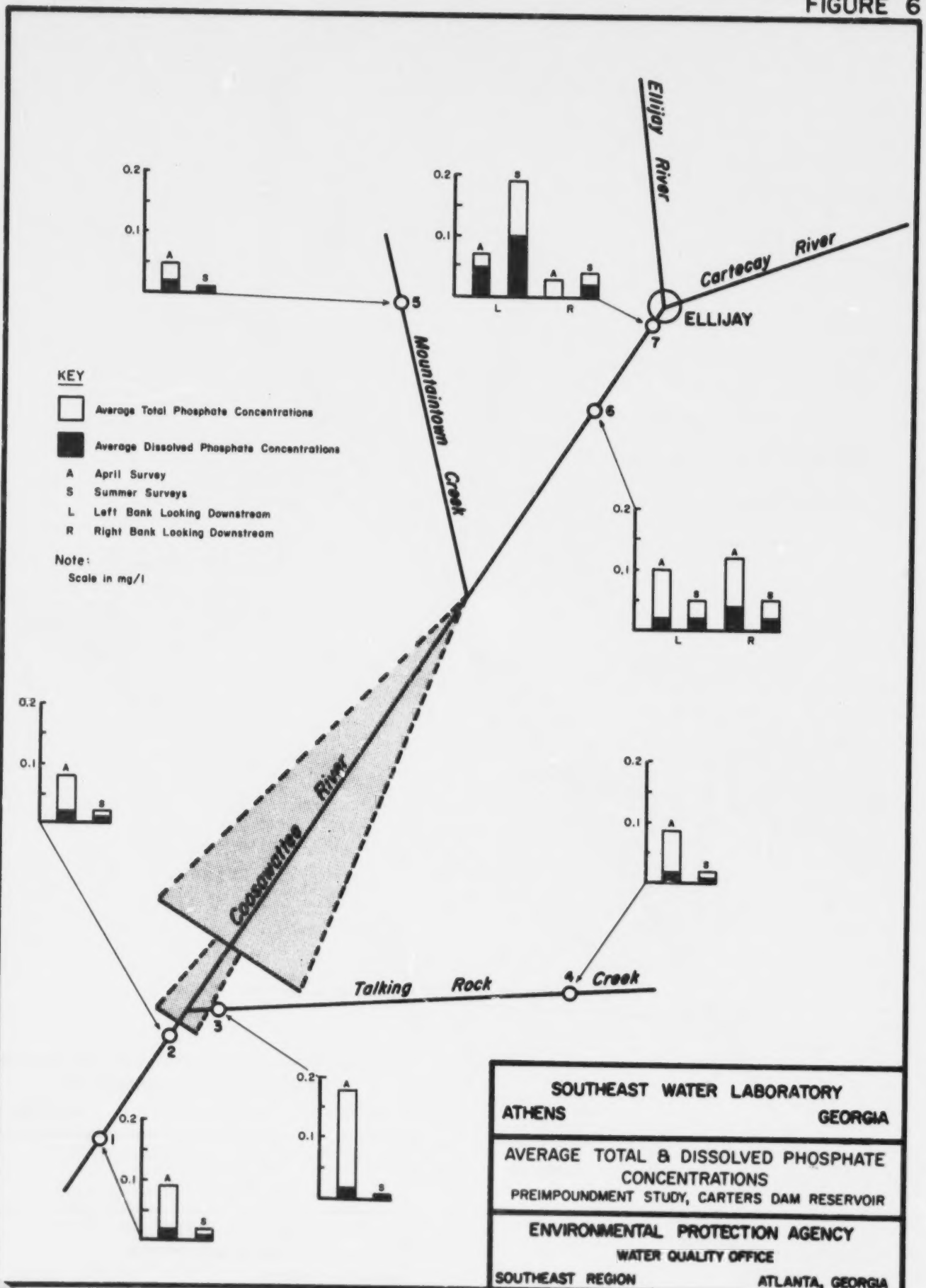
* Secondary treatment now installed. See footnote on page 2.



SOUTHEAST WATER LABORATORY
ATHENS GEORGIA

AVERAGE NITROGEN CONCENTRATIONS
PREIMPOUNDMENT STUDY
CARTERS DAM RESERVOIR

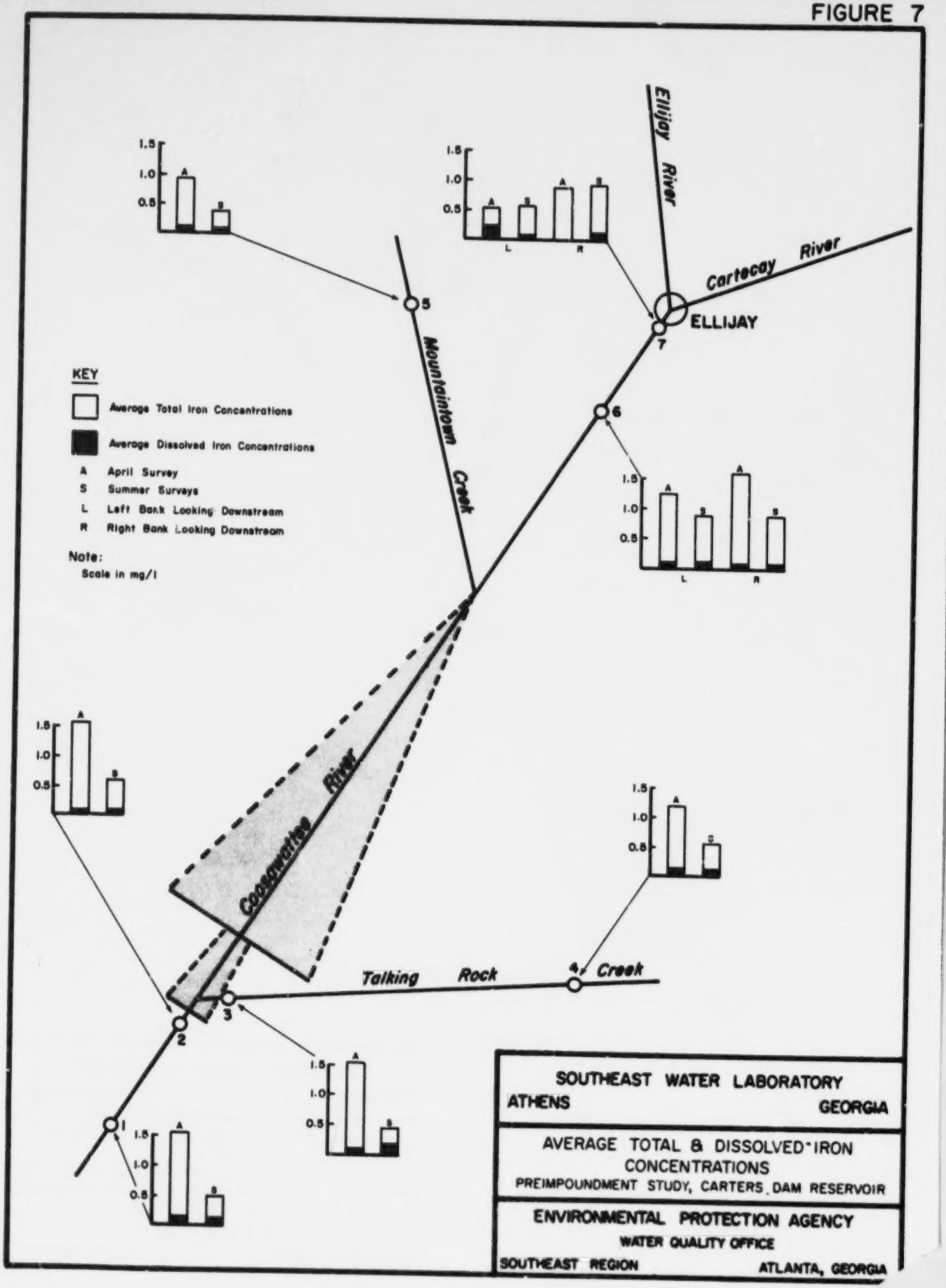
ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA



SOUTHEAST WATER LABORATORY
ATHENS GEORGIA

AVERAGE TOTAL & DISSOLVED PHOSPHATE CONCENTRATIONS
PREIMPOUNDMENT STUDY, CARTERS DAM RESERVOIR

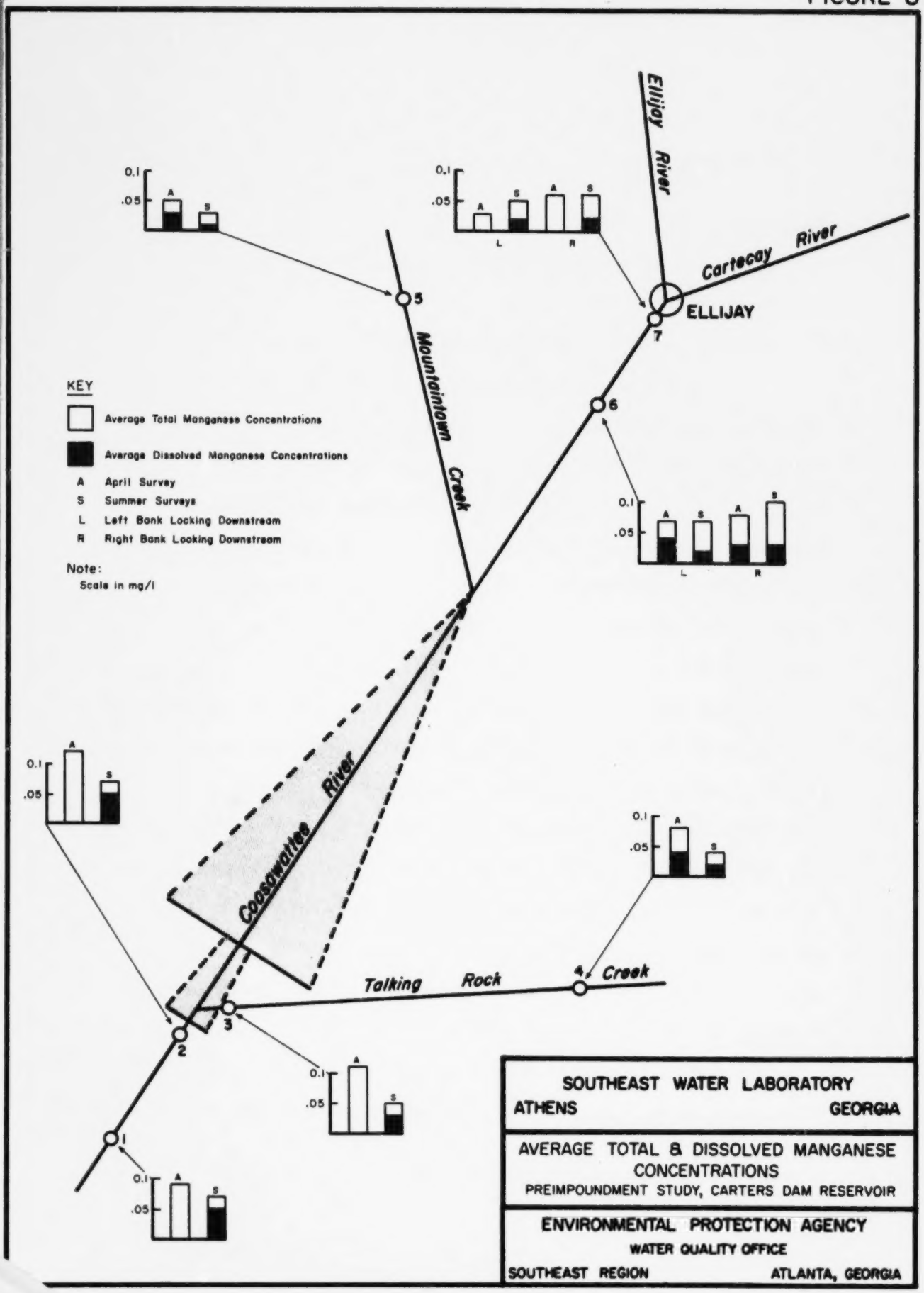
ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA



SOUTHEAST WATER LABORATORY
ATHENS GEORGIA

AVERAGE TOTAL & DISSOLVED IRON CONCENTRATIONS
PREIMPOUNDMENT STUDY, CARTERS DAM RESERVOIR

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA



SOUTHEAST WATER LABORATORY
ATHENS GEORGIA

AVERAGE TOTAL & DISSOLVED MANGANESE CONCENTRATIONS
PREIMPOUNDMENT STUDY, CARTERS DAM RESERVOIR

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE
SOUTHEAST REGION ATLANTA, GEORGIA

might be expected to occur within the hypolimnetic discharges and in the lake during turnover of stratified waters.

Bacterial Quality

All bacterial data are contained in Appendix D. These data are summarized in Table 3.

With one exception, the reservoir drainage area was free from major bacterial pollutional sources. The City of Ellijay, Georgia discharged untreated domestic and industrial wastes into the Ellijay River upstream from Station 7 (Figure 2).* The impact of these wastes on the bacterial water quality is shown in Table 3. Immediately upstream from Station 7, Georgia Broiler's poultry processing plant discharged untreated wastes directly into the Coosawattee River. This waste entered the stream on the left bank and did not mix completely for some distance downstream.

The mean fecal coliform (FC) densities measured along the right and left banks of the stream at Station 7 reflected both the severity of bacterial pollution and the lack of complete mixing of wastes at that point (Table 3). Densities of 48,000 and 6400/100 ml for the left and right banks of Station 7, respectively, not only showed bacterial pollution from the poultry plant but also the significant fecal pollution in the Ellijay River prior to the addition of the poultry wastes. All these wastes will be treated in the new Ellijay waste treatment plant after November 1971.*

About one mile further downstream (Stations 6R and 6L) on the Coosawattee River, the effect of fecal discharges from the Ellijay area

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* Secondary treatment now installed. See footnote on page 2.

TABLE 3

SUMMARY OF BACTERIAL DATA

Entire Study Period

Station	TOTAL COLIFORM/100 ml		FECAL COLIFORM/100 ml	
	Arith. Mean	Geo. Mean	Arith. Mean	Geo. Mean
1	14,000	4,600	890	190
2	14,000	3,000	770	160
3	11,000	2,200	570	120
4	15,000	3,500	490	140
5	6,500	2,100	1,500	250
6R	57,000	35,000	7,200	4,400
6L	46,000	31,000	9,000	5,400
7R	46,000	38,000	7,700	6,400
7L	180,000	160,000	76,000	48,000
		April 1968		
1	9,500	3,200	1,600	470
2	9,500	2,600	1,400	280
3	2,500	700	1,100	180
4	5,200	1,300	120	50
5	7,000	1,300	2,700	300
6R	27,000	16,000	3,700	1,500
6L	25,000	16,000	4,000	2,000
7R	11,000	11,000	1,800	1,800
7L	110,000	110,000	19,000	19,000
		July 1968		
1	25,000	23,000	180	160
2	26,000	25,000	270	260
3	29,000	26,000	80	80
4	36,000	29,000	1,100	700
5	7,500	7,300	200	180
6R	100,000	96,000	9,100	8,700
6L	65,000	62,000	10,000	9,500
7R	65,000	62,000	10,000	8,700
7L	190,000	177,000	51,000	46,000

was still evident. Although the geometric mean bacterial densities had been reduced to 4400 and 5400 FC/100 ml along the right and left banks respectively, such levels constitute a hazard to recreational use of the river.[1/] Good operation (especially disinfection) of the new waste treatment plant at Ellijay will be essential to protect the recreational use of these waters.

As shown in Table 3, the bacterial water quality of the remainder of the study area was relatively good. Bacterial indicator levels throughout the study area were affected by periodic, localized, heavy rainfall. A comparison of the mean coliform levels measured during April 1968 with those during July 1968 reflects the impact of stormwater runoff on bacterial water quality.

During the July 1968 study period total coliform levels were considerably higher than during April 1968 and July 1969 and 1970. These higher indicator levels resulted from rainfall on two of three sampling days. Although a greater amount of rainfall occurred in April 1968 the full effect of the increased flows was not measured because of sampling frequency. Total coliform levels for July 1968 were much higher than for the other sampling periods without corresponding high fecal coliform levels. The presence of these high non-fecal coliform concentrations during the high runoff period indicate that most of these organisms were native soil forms.

Biological Quality

One hundred and twenty-five species of invertebrates were collected from study area streams. The Biotic Index for Stations 1 through 6 and for Station 7R ranged from 18 to 44. Station 7L showed the effects of

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1/ No interstate water quality standards apply in the study area.

organic enrichment (poultry plant effluent) and had a Biotic Index value of 2.* To facilitate the comparison of biological findings, the Biotic Index values for each Station are presented in Figure 9. Additional detailed biotic information may be found in Appendix D.

Aquatic habitats at Station 1 and 2 were physically similar. Bottom deposits consisted primarily of clay and coarse, shifting sand which caused generally turbid water; visibility was less than 2 feet. A few small shallow coves along both shorelines contained thin deposits of silt overlying sand. Meager growths of submerged vegetation were found in these coves. Apparently scouring effects and turbidity had prevented lush growths of aquatic vegetation.

An exceptionally rich invertebrate fauna was collected from dead leaf drift held against the upstream side of submerged tree limbs by the swift currents. This leaf habitat provided the food and shelter not provided by the shifting sand bottom or the minimal aquatic vegetation. The lack of diverse habitat resulted in less variety of organisms collected. Accordingly, the Biotic Index values at Station 1 and 2 were lower than values at other areas having more diverse habitats (Stations 3, 4 and 5). This does not mean the water quality at Stations 1 and 2 was lower than the quality elsewhere in the surveyed area. In this case, the Index was merely a reflection of less organism variety because of fewer adequate habitats.

Stations 3, 4 and 5 were physically and biologically similar. These stations were located on two tributaries of the Coosawattee River -- Talking Rock Creek (Stations 3 and 4) and Mountaintown Creek (Station 5).

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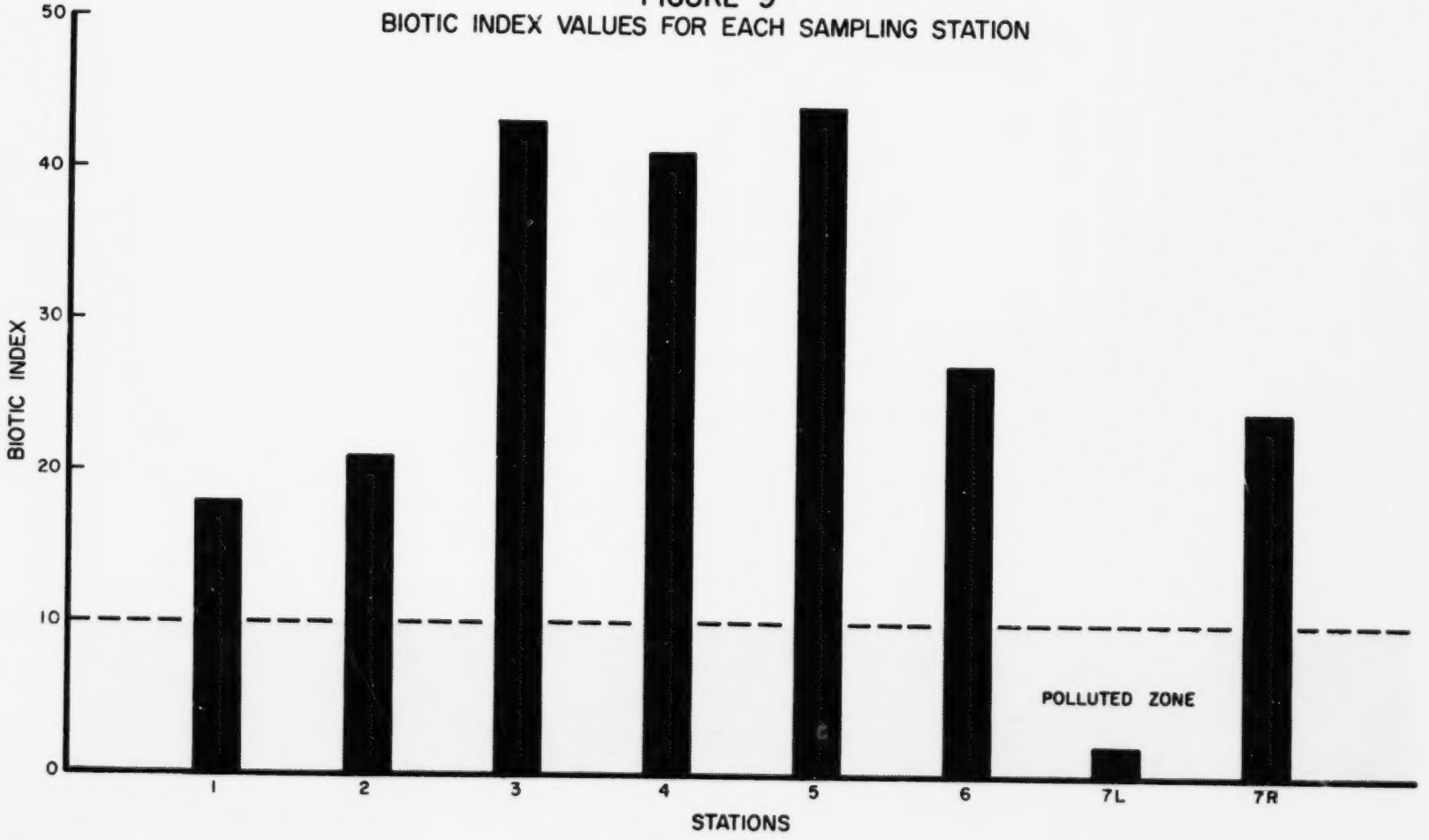
* Secondary treatment now installed. See footnote on page 2.

FIGURE 9
BIOTIC INDEX VALUES FOR EACH SAMPLING STATION



This biosphere provided suitable substrate for numerous species with extensive rock riffle aquatic vegetation, leaf drift, submerged logs, boards and other objects.

Stoneflies, lotic mayflies, hellgrammites, blackflies, riffle beetles, and orthoclad midges were among many sensitive (with respect to organic pollution) organisms collected. Biotic Index values ranging in the 40's reflected clean water conditions (Figure 9).

The lower end of Station 6 (150 foot wide transect) was located beneath the Highway 5 bridge crossing. This location permitted the examination of debris held against the bridge pilings by the river flow. Layers of chicken feathers were lodged in debris jammed against the pilings. Downstream, a refuse disposal fill occupied one shoreline while a small junkyard, some cars partially submerged, occupied the adjacent shoreline. Although the area was undesirable from a recreational standpoint, the aquatic environment adequately supported a diverse invertebrate community. Numerous pollution sensitive forms, e.g. stoneflies, heptageniid mayflies, and orthoclad midge larvae, were collected; consequently, the Biotic Index was above the value considered indicative of pollution.

Station 7 was located between two large rock riffle areas. Currents in the upstream riffle suspended silt, sand and clay, and made the water slightly turbid as it flowed past the sampling station.

The shoreline of Station 7R was littered with cans and other debris. The submerged debris provided suitable niches for stoneflies, mayflies and some midge larvae. Aquatic worms, macro-crustaceans, midge larvae, caddisflies and a variety of other organisms (Appendix D) were collected

from shoreline silt deposits and leaf drift. The absence of severe organic pollution at Station 7R was reflected by the diverse "shoreline" fauna.

In checking the water quality of Station 7L, the relative change in the faunal community was striking. The nature of the species found as well as the aesthetic condition of the stream indicated excessive organic enrichment. Blood-red wastewater flowed from the poultry processing plant into the river. The left bank was littered with chicken feathers, and poultry entrails clung to the upstream side of submerged rock and vegetation.*

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* Secondary treatment now installed. See footnote on page 2.

WATER QUALITY AND BIOLOGICAL CHANGES FOLLOWING IMPOUNDMENT

WATER QUALITY

Impoundment of the Coosawattee River and its tributaries will cause water quality changes. Increased detention time and sunlight exposure will cause increased rates of bacterial dieoff. This should produce acceptable bacterial levels within the lake for primary contact recreation -- provided that industrial and sanitary wastes upstream receive secondary treatment and chlorination, which is scheduled for November 1971.

Decreased inorganic nutrient concentrations[1/] between reservoir influent points and waters released at the dam are a reflection of the various mechanisms by which reservoir eutrophication processes occur. If tributary nutrient levels are too high, nuisance biological problems associated with accelerated eutorphication can occur. At the time of the preimpoundment survey, there was no indication that accelerated eutrophication would be a problem. The levels of nitrogen and phosphorus in the study area streams were similar to those found in many impounded waters in the Southeastern U. S. where no nuisance growth problems exist. Completion of Ellijay's waste treatment facilities will further reduce the potential for reservoir eutrophication.*

1/ Principally carbon, nitrogen, and phosphorus.

* Secondary treatment now installed. See footnote on page 2.

Cost justification for the Carters Dam Reservoir includes recreational uses. The Corps of Engineers has limited authority toward controlling watershed development -- this control being necessary to protect recreational uses. Local and state planning authorities should insure that development will protect these uses. This means adequate treatment of any municipal or industrial wastes which may be introduced directly into the reservoir. Nitrogen, phosphorus, and carbon from municipal and industrial wastes and agricultural runoff should be held to a minimum. Within the reservoir proper, it is advisable to promulgate regulations prohibiting waste discharges from watercraft.

Thermal stratification will exist to an extent in the main reservoir. As a result, DO deficits will occur in the hypolimnion and low level releases containing low DO concentrations could result in low concentrations downstream. The effect of pumped storaged on prevention of stratification is not known at this time. Experience at other pumped storage projects has not been sufficiently documented to predict what might occur at the Carters project. Any mixing from backpumping should have some beneficial effect, however.

BIOLOGY

Many European and American scientists have studied biological succession in new reservoirs, and sufficient data are available to predict changes in aquatic biota to be expected in Carters Dam Reservoir.

A typical history of the biological development of Carters Dam Reservoir could be as follows:

> As the reservoir fills, terrestrial plants will be flooded and will die. The accumulating detritus will provide basic nutrients to help stimulate plankton development in the upper strata of the lake. Within a two-year period, plankton growth usually stabilizes to an acceptable level, i.e. unless external nutrient sources create accelerated eutrophication of the lake.

Mud and fine loam deposits from runoff will begin to cover the lake floor as impoundment continues. The developing reservoir will at first be uncharacteristic of a lake. Drift organisms from tributary streams will inhabit the reservoir. Some of these organisms will survive only a short time in the silt bottom deposits of the lake. Other drift organisms more tolerant of these lentic conditions will begin to establish new colonization along the shallow lake shoreline. Submerged vegetation will supply ample niches for various worms, crustaceans, mites, insects and their larvae (4). In the deeper open water, accumulating organic bottom materials will provide food and habitat for increasing numbers of midge larvae. According to Schneider (5), these insects are potential nuisance organisms and will eventually dominate the lake bottom.

The developing lake will undergo natural changes in fish population also. Stream species will be replaced by typical lake fish. Newly flooded areas, abundant with invertebrates, will supply vast feeding and spawning grounds for the fish. An initial increase in fish population will be reduced as fish-food and space become more limited and finally a reservoir ecosystem is established. With proper management, the fishery potential of the new reservoir is excellent.

Changes in the diverse biota of the tributary streams should be minor if it is assumed that development of the watershed will be limited in the future. In the lower flooded reaches of these streams, however, flow will be reduced and one can expect lentic species to gradually replace lotic forms. Other changes included an increased fish population as discussed above.

Biological changes downstream from the dam are the most difficult to predict. Previous work on reservoir tailwaters has dealt with water from either epilimnion or hypolimnion releases. On the benefit side, controlled releases from the reservoir will reduce the scouring of invertebrates (fish-food) which probably occurs now during high flow periods. However, there may be detrimental effects to the existing diverse, "clean stream" benthic biota and to existing fish life if low DO concentrations occur in release waters.

The success of the Carters Dam Lake project in improving downstream biological conditions is dependent on the release of water from the reservoir of a quality capable of supporting a healthy biological community (similar to that which now exists).

1. American Public Health Association, Standard Methods for the Examination of Water and Wastewater, Twelfth Edition, 1965.

2. Federal Water Pollution Control Administration, FWPCA Methods for Chemical Analysis of Water and Wastes, November 1969.

3. Geldreich, E. E., Clark, H. F., Huff, C. B., and Best, L. C., "Fecal Coliform Organism Medium for Membrane Filter Techniques," Journal American Water Works Association, 57, No. 2, February 1965.

4. Dendy, J. S., "The Fate of Animals in Stream Drift When Carried Into Lakes," Ecological Monographs, 14, pp 333-357, 1944.

5. Schneider, Robert F., "Seasonal Succession of Certain Invertebrates in a Northwestern Florida Lake," Quarterly Journal Florida Academy of Science, 25, pp 127-141, 1962.

APPENDIX A

REQUEST FOR STUDY
FWPCA REPLY

COPY

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DEPARTMENT OF THE ARMY
Mobile District, Corps of Engineers
2301 Airport Blvd. P.O. Box 2288
Mobile, Alabama 36601

In Reply Refer To

10 October 1967

SAMEN-PW

Regional Program Director
Federal Water Pollution Control
Administration
Room 404
50 Seventh Street
Atlanta, Georgia 30323

Dear Sir:

It is essential that a preimpoundment water quality study be made of the Coosawattee River at the Carters damsite located 26.8 river miles upstream from the mouth of the river near Chatsworth, Georgia. This study which should cover the portion of the river that traverses the proposed impoundment area and that area immediately downstream of the dam should include total and dissolved iron and manganese determinations along with the usual parameters. A determination should also be made of all sources contributing waste discharge to the river in this area with their quantities of flow and constituent characteristics. Water supply points should also be located and reported.

It is requested that the FWPCA undertake this study. Since the closure of the dam is scheduled for September 1971, it is believed that there is sufficient time to conduct the necessary investigations during critical periods. If you can accomplish this survey within the above time frame your estimate of cost for the investigations and preparation of a report would be appreciated.

Sincerely yours,

B. J. CHRISTIANSEN
Chief, Planning and Reports Branch

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U. S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
Southeast Region
Room 404 - 50 Seventh Street, N. E.
Atlanta, Georgia 30323

December 12, 1967

Col. Robert C. Marshall
District Engineer
U. S. Army Engineer District
P. O. Box 1169
Mobile, Alabama 36601

Attn: B. J. Christiansen

Dear Sir:

The following is furnished in response to your request of October 10, 1967 for a preimpoundment study at Carter's Dam near Chatsworth, Georgia. A limited amount of water quality data in the reservoir area was collected in the summer of 1966 by our staff in the Atlanta office. To supplement these data, particularly with regard to iron and manganese determinations, we would propose that studies be conducted in March and July 1968. A report describing the preimpoundment water quality which would include a list of waste sources, water supply points, and information on the quality of all significant tributary streams would be prepared during the latter half of the calendar year 1968.

The timing of these supplemental studies would be made to coincide with the destratification studies to be conducted on nearby Allatoona Reservoir.

Estimated costs for completion of the field studies and report is $4,000. We would be pleased to perform this investigation for you and will look forward to your approval of this study at your earliest convenience.

Sincerely yours,

John R. Thoman
Director, Southeast Region

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DEPARTMENT OF THE ARMY
Mobile District, Corps of Engineers
2301 Airport Blvd. P.O. Box 2288
Mobile, Alabama 36601

In Reply Refer To

21 December 1967

SAMEN-PW

Regional Program Director
Federal Water Pollution Control
Administration
Room 404
50 Seventh Street, N. E.
Atlanta, Georgia 30323

Dear Sir:

Reference is made to your letter dated 12 December 1967, outlining your proposed schedule and cost estimate for preimpoundment studies at Carter's Dam, Georgia.

It is requested that you proceed with this study according to your proposed schedule. As indicated in your letter, $4,000 is authorized for this study. Request for reimbursement of costs should be made quarterly using Standard Form 1080.

Sincerely yours,

B. J. CHRISTIANSEN
Chief, Planning and Reports Branch

APPENDIX B

DESCRIPTION OF SAMPLING STATIONS

Station Number	Location
1	Coosawattee River - S-1800 bridge, over Coosawattee River 5 miles downstream from dam. (Gordon County)
2	Coosawattee River - U. S. 411 bridge 1 mile downstream from dam and downstream from Talking Rock Creek. (Murray County) U.S.G.S. gage #3825
3	Talking Rock Creek - State Highway 156 bridge (Murray County) approximately 2½ miles upstream from re-regulation dam.
4	Talking Rock Creek - State Highway 156 bridge (Pickens County) approximately 12 miles upstream from re-regulation dam.
5	Mountaintown Creek - State Highway 282 bridge (Gilmer County) approximately 4 miles upstream from Coosawattee River.
6	Coosawattee River - State Highway 5 bridge (Gilmer County) downstream from Elijay's and poultry wastes. (U.S.G.S. gage #3805 here.) Left and right banks sampled to account for left bank poultry wastes 1 mile upstream.
7	Coosawattee River - SR 282 bridge (Gilmer County) 50 yards downstream from Georgia Broilers poultry processing plant. Left and right banks sampled to account for poultry wastes on left bank.

APPENDIX C

1966
COMPREHENSIVE PROGRAM DATA

TABLE C-1
STATION 2
JULY-AUGUST 1966

Date	Time	Flow Cu Ft/Sec	Temp Cent	DO mg/l	DO Sat %	BOD 5 Day mg/l	pH	T Alk $CaCO_3$ mg/l
7/13	1105	1057	26	8.2	100	2.0	6.8	11
7/15	1027	1053	25	8.1	96	1.9	6.6	11
7/18	1047	1053	22	8.6	98	2.2	6.6	11
7/19	1002	1053	23	8.4	96	1.3	6.8	11
7/20	1028	1052	23	8.5	98	1.0	6.8	10
7/22	1105	570	23	8.7	100	0.9	6.7	14
7/25	1012	512	22	8.7	99	1.4	6.4	9
7/26	1045	506	24	8.7	102	1.1	6.5	9
7/27	1008	535	23	8.6	99	1.2	6.6	9
7/29	1026	500	25	8.3	99	--	6.6	9
8/1	1145	586	23	8.8	101	1.5	7.1	24
8/2	1040	541	23	8.5	98	1.4	6.9	11
8/3	1012	343	22	8.3	94	1.4	6.9	11
	MEAN	720	23	8.4	98	1.4	6.7	12

TABLE C-1 (cont'd)
STATION 3
JULY--AUGUST 1966

Date	Time	Flow Cu Ft/Sec	Temp Cent	DO mg/l	DO Sat %	BOD 5 Day mg/l	pH	T Alk $CaCO_3$ mg/l
7/13	1120	--	26	8.4	102	1.8	7.4	26
7/15	1048	--	26	8.3	101	1.6	7.4	29
7/18	1030	--	24	8.8	104	1.7	7.4	26
7/19	1017	--	24	8.4	99	1.5	7.2	26
7/20	1010	--	23	8.3	95	1.4	7.4	27
7/22	1120	--	23	8.8	101	1.3	7.7	26
7/25	1056	--	22	8.4	95	1.1	7.0	28
7/26	1100	--	23	8.5	98	1.5	7.2	28
7/27	0955	--	23	8.4	97	1.1	7.1	26
7/29	1030	--	24	8.0	94	--	--	--
8/1	1130	--	23	8.8	101	1.7	7.4	30
8/2	1053	118	23	8.7	100	1.7	7.5	30
8/3	100	90	23	8.3	95	0.9	7.3	32
	MEAN	104	24	8.4	99	1.4	7.3	28

TABLE C-1 (cont'd)
STATION 6
JULY-AUGUST 1966

Date	Time	Flow Cu Ft/Sec	Temp Cent	DO mg/l	DO Sat %	BOD 5 Day mg/l	pH	T Alk $CaCO_3$ mg/l
7/13	1210	425	24	8.3	98	4.3	6.7	9
7/15	1130	403	24	7.7	90	3.2	6.6	11
7/18	0950	408	20	8.3	90	2.8	6.4	10
7/19	1155	386	21	8.3	92	3.7	6.6	9
7/13	1210	--	--	--	--	--	--	--
7/19	1155	392	20	8.2	89	2.7	6.6	9
7/20	0925	--	21	8.8	98	4.2	6.9	12
7/22	1203	304	20	7.9	86	2.9	6.2	7
7/25	0915	310	21	8.6	96	4.2	6.3	8
7/26	1140	320	21	7.8	87	2.7	6.6	9
7/29	1106	289	23	7.3	84	--	--	--
8/1	1030	326	20	8.3	90	3.7	6.7	9
8/2	1135	304	21	8.0	89	--	6.7	10
8/3	0927	369	20	7.7	84	1.9	6.6	9
	MEAN	353	21	8.1	90	3.3	6.6	11

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APPENDIX D

1968-1970
WATER QUALITY DATA

TABLE D-1
CARTERS DAM
SPRING - APRIL 1968 - SURVEY

Date	Time	DO mg/l	Water Temp °C	DO Sat %	BOD_5 mg/l	Tot Hardness mg/l as $CaCO_3$	Tot Alk mg/l as $CaCO_3$	pH	Turb JTU	Color Pt-Co. U	Conductivity µmho	Phosphate mg/l as P Total	Phosphate mg/l as P Dissolved	Manganese mg/l Total	Manganese mg/l Dissolved	Iron mg/l Total	Iron mg/l Dissolved	TKN mg/l	NH_3-N mg/l	NO_3+NO_2-N mg/l
										STATION 1										
4	0945	10.5	16	105	0.8	10.2	10.0	7.1	<25	15	32	0.02	0.01	0.04	--	0.43	0.07	0.56	0.50	0.08
5	1240	9.9	14	95	2.2	12.0	13.0	6.7	240	40	29	0.27	0.04	0.23	0.10	4.77	0.23	0.43	0.22	0.13
8	1240	9.8	15	96	0.3	14.0	12.0	6.8	<25	35	28	0.03	0.01	0.05	--	0.41	0.10	0.08	0.03	0.11
9	1420	9.9	14	95	0.4	12.0	10.0	6.7	<25	20	34	0.04	0.01	0.06	--	0.71	0.20	0.08	0.04	0.12
	MEAN	10.0	15	98	0.9	12.0	11.2	6.8	79	28	31	0.09	0.02	0.09	0.10	1.58	0.15	0.29	0.20	0.11
	MAX	10.5	16		2.2	14.0	13.0	7.1	240	40	34	0.27	0.04	0.23		4.77	0.23	0.56	0.50	0.13
	MIN	9.8	14		0.3	10.2	10.0	6.7	<25	15	28	0.02	0.01	0.04		0.41	0.07	0.08	0.03	0.08
										STATION 2										
4	1110	10.8	14	104	1.0	10.0	10.0	7.3	<25	10	33	0.02	0.01	0.08	0.06	0.46	0.09	0.10	0.07	0.07
5	1140	10.1	14	97	4.3	16.0	13.0	6.8	250	30	28	0.25	0.04	0.23	--	4.75	0.10	0.31	0.17	0.14
8	1355	10.0	14	96	0.4	20.0	9.0	7.3	<25	25	27	0.03	0.00	0.08	0.05	0.51	0.09	0.10	0.06	0.09
9	1330	10.1	14	97	0.6	14.0	10.0	6.7	<25	15	33	0.02	0.01	0.08	--	0.43	0.09	0.09	0.08	0.10
	MEAN	10.2	14	98	1.6	15.0	10.5	7.0	81	20	30	0.08	0.02	0.12	0.06	1.54	0.09	0.15	0.10	0.10
	MAX	10.8	14		4.3	20.0	13.0	7.3	250	30	33	0.25	0.04	0.23	0.06	4.75	0.10	0.31	0.17	0.14
	MIN	10.0	14		0.4	10.0	9.0	6.7	<25	10	27	0.02	0.00	0.08	0.05	0.43	0.09	0.09	0.06	0.07
										STATION 3										
4	1035	10.9	16	109	1.2	15.4	16.0	7.4	<25	10	41	0.01	0.00	0.02	0.01	0.22	0.10	0.07	0.02	0.02
5	1210	10.1	14	97	2.2	11.0	16.0	7.1	210	45	35	0.67	0.06	0.37	0.34	5.35	0.17	0.25	0.14	0.13
8	1325	10.1	14	97	1.8	20.0	17.0	6.8	<25	20	39	0.02	0.01	0.03	0.02	0.34	0.10	0.07	0.01	0.08
9	1400	10.2	14	99	0.3	18.0	17.0	6.6	<25	15	43	0.02	0.01	0.02	--	0.27	0.11	0.05	0.02	0.08
	MEAN	10.3	14	100	1.4	16.1	16.5	7.0	71	22	40	0.18	0.02	0.11	0.12	1.54	0.12	0.11	0.05	0.08
	MAX	10.9	16		2.2	20.0	17.0	7.4	210	45	43	0.67	0.06	0.37	0.34	5.35	0.17	0.25	0.14	0.13
	MIN	10.1	14		0.3	11.0	16.0	6.6	<25	10	35	0.01	0.00	0.02	0.01	0.22	0.10	0.05	0.01	0.02
										STATION 4										
4	1315	10.7	15	105	0.2	18.2	19.0	6.9	<25	10	46	0.01	--	0.05	0.05	0.27	0.09	0.07	0.02	0.04
5	0910	10.0	13	94	2.2	19.8	18.0	7.0	235	15	39	0.31	0.04	0.19	0.07	3.85	0.18	0.27	0.14	0.12
8	1440	10.3	13	97	0.0	22.0	20.0	7.1	<25	15	41	0.02	0.01	0.03	0.01	0.35	0.10	0.31	0.04	0.08
9	1030	10.6	14	102	0.6	20.0	20.0	6.8	<25	15	50	0.02	--	0.03	--	0.28	0.15	0.07	0.05	0.09
	MEAN	10.4	14	100	0.8	20.0	19.2	7.0	78	14	44	0.09	0.02	0.08	0.04	1.19	0.13	0.18	0.06	0.08
	MAX	10.7	15		2.2	22.0	20.0	7.1	235	15	50	0.31	0.04	0.19	0.07	3.85	0.18	0.31	0.14	0.12
	MIN	10.0	13		0.0	18.2	18.0	6.8	<25	10	39	0.02	0.01	0.03	0.01	0.27	0.09	0.07	0.05	0.04

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TABLE D-1 (Contd.)
CARTERS DAM
SPRING - APRIL 1968 - SURVEY

Date	Time	DO mg/l	Water Temp °C	DO Sat %	BOD_5 mg/l	Tot Hardness mg/l as $CaCO_3$	Tot Alk mg/l as $CaCO_3$	pH	Turb JTU	Color Pt-Co. U	Conductivity µmho	Phosphate mg/l as P Total	Phosphate mg/l as P Dissolved	Manganese mg/l Total	Manganese mg/l Dissolved	Iron mg/l Total	Iron mg/l Dissolved	TKN mg/l	NH_3-N mg/l	NO_3+NO_2-N mg/l
											STATION 5									
4	1155	10.6	16	106	1.1	4.6	6.0	7.1	<25	10	16	0.02	--	0.04	0.03	0.27	0.06	0.10	0.03	0.11
5	1100	10.2	13	96	0.7	5.2	7.0	7.3	91	15	16	0.16	0.03	0.13	0.08	2.97	0.11	0.11	0.06	0.11
8	1610	11.8	14	113	0.4	6.0	6.0	7.1	<25	10	17	0.02	0.01	0.02	0.01	0.37	0.10	0.06	0.03	0.05
9	1245	10.0	14	96	0.0	6.0	5.0	7.1	<25	10	19	0.01	0.01	0.02	0.01	0.20	0.08	0.05	0.04	0.04
	MEAN	10.6	14	103	0.6	5.4	6.0	7.2	42	11	17	0.05	0.02	0.05	0.03	0.95	0.09	0.08	0.04	0.08
	MAX	11.8	16		1.1	6.0	7.0	7.3	91	15	19	0.16	0.03	0.13	0.08	2.97	0.11	0.11	0.06	0.11
	MIN	10.0	13		0.0	5.0	5.0	7.1	<25	10	16	0.01	0.01	0.02	0.01	0.20	0.06	0.05	0.03	0.04
											STATION 6L									
4	1225	10.4	14	100	2.4	5.6	8.0	7.2	<25	15	22	0.05	0.03	0.04	0.02	0.30	0.06	0.32	0.22	0.08
5	1025	9.9	14	95	2.3	7.0	8.5	6.9	260	30	22	0.29	0.01	0.19	0.09	4.05	0.19	0.34	0.20	0.28
8	1530	8.2	13	77	1.5	8.0	8.0	7.0	<25	15	21	0.04	0.00	0.02	0.02	0.33	0.09	0.27	0.15	0.12
9	1140	10.0	13	94	1.8	8.0	7.0	7.1	<25	15	24	0.03	0.02	0.03	0.02	0.27	0.06	0.18	0.13	0.12
	MEAN	9.6	14	92	2.0	7.2	7.9	7.0	84	19	22	0.10	0.02	0.07	0.04	1.24	0.10	0.28	0.18	0.15
	MAX	10.4	14		2.4	8.0	8.5	7.2	260	30	24	0.29	0.03	0.19	0.09	4.05	0.19	0.34	0.22	0.28
	MIN	8.2	13		1.5	5.6	7.0	6.9	<25	15	21	0.03	0.00	0.02	0.02	0.27	0.06	0.18	0.13	0.08
											STATION 6R									
4	1240	10.6	16	106	2.1	4.8	7.5	7.0	<25	15	23	0.06	--	0.04	0.03	0.30	0.06	0.18	0.11	0.08
5	1005	9.8	14	94	3.0	7.0	9.0	6.9	265	30	22	0.36	0.08	0.24	0.07	5.60	0.18	0.61	0.42	0.27
8	1545	8.0	14	77	1.4	10.0	6.0	7.1	<25	15	21	0.03	0.01	0.02	0.02	0.35	0.06	0.15	0.10	0.11
9	1210	10.2	14	98	2.2	6.0	7.0	7.0	<25	15	22	0.04	0.02	0.02	0.01	0.27	0.03	0.11	0.08	0.11
	MEAN	9.6	14	94	2.2	7.0	7.4	7.0	85	19	22	0.12	0.04	0.08	0.03	1.63	0.08	0.26	0.18	0.14
	MAX	10.6	16		3.0	10.0	9.0	7.1	265	30	23	0.36	0.08	0.24	0.07	5.60	0.18	0.61	0.42	0.27
	MIN	8.0	14		1.4	4.8	6.0	6.9	<25	15	21	0.03	0.01	0.02	0.01	0.27	0.03	0.11	0.08	0.08
											STATION 7L									
10	1115	9.6	12	89	4.1	12.0	7.0	--	<25	15	25	0.07	0.05	0.03	0.10	0.54	0.25	0.39	0.16	0.11
											STATION 7R									
10	1130	9.8	12	91	1.7	10.0	7.0	--	<25	15	21	0.03	--	0.06	--	0.89	--	0.18	0.07	0.10

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TABLE D-2
CARTERS DAM
SUMMER - 1968-1969-1970 - SURVEYS

Date	Time	DO mg/l	Water Temp °C	DO Sat %	BOD_5 mg/l	Tot Hardness mg/l as $CaCO_3$	Tot Alk mg/l as $CaCO_3$	pH	Turb JTU	Color Pt-Co. U	Conductivity µmho	Phosphate mg/l as P Total	Phosphate mg/l as P Dissolved	Manganese mg/l Total	Manganese mg/l Dissolved	Iron mg/l Total	Iron mg/l Dissolved	TKN mg/l	NH_3-N mg/l	NO_3+NO_2-N mg/l
											STATION 1									
7/9/68	1400	8.7	20	95	--	20.0	11.3	7.3	13.5	10	30	0.02	0.01	0.04	0.03	0.56	0.14	0.18	0.15	0.08
7/10/68	1030	8.4	20	91	--	20.0	12.8	7.1	15.5	10	31	0.02	0.01	0.04	0.02	0.46	0.14	0.54	0.18	0.09
7/11/68	1250	7.9	18	86	0.7	14.0	11.6	6.8	18.0	10	31		0.01	--	0.02	--	0.12	--	--	--
9/16/68	1100	8.3	20	90	--	13.0	14.0	7.2	6.5	25	36	0.02	--	0.07	0.05	0.42	0.12	0.50	0.07	0.05
7/9/70	0845	7.4	22	84	0.8	14.0	9.0	7.1	4.5	--	41	0.02	0.01	0.12	0.11	0.54	0.08	0.14	0.04	0.03
	MEAN	8.2	20	89	0.8	16.2	11.7	7.1	11.6	14	34	0.02	0.01	0.07	0.05	0.50	0.12	0.34	0.11	0.06
	MAX	8.7	22		0.8	20	14.0	7.3	18.0	25	41	0.02	0.01	0.12	0.11	0.56	0.14	0.54	0.18	0.09
	MIN	7.4	18		0.7	13	9.0	6.8	4.5	10	30	0.02	0.01	0.04	0.02	0.42	0.08	0.14	0.04	0.03
											STATION 2									
7/9/68	1500	8.1	20	88		18.0	11.5	7.3	13.5	10	29	0.02	0.01	0.04	0.02	0.61	0.15	0.59	0.08	0.08
7/10/68	0900	8.1	19	86		16.0	11.6	7.1	17.0	10	27	0.02	0.01	0.03	0.01	0.57	0.11	0.31	0.11	0.09
7/11/68	1345	8.0	20	87	0.5	12.0	11.8	6.8	18.0	10	31	0.02	0.01	0.05	0.01	0.95	0.11	7.15*	2.08*	0.10*
9/16/68	1125	9.0	20	98		11.0	14.0	7.1	5.5	25	30	0.02		0.09	--	0.37	0.16	0.25	0.23	0.08
7/19/70	0935	7.9	22	90	0.4	13.0	12.0	7.1	3.0	--	42	0.02	0.01	0.13	0.13	0.57	0.05	0.10	0.04	0.06
	MEAN	8.2	20	90	0.4	14	12.2	7.1	11.3	14	32	0.02	0.01	0.07	0.04	0.61	0.12	0.32	0.12	0.08
	MAX	9.0	22		0.5	18.0	14.0	7.3	18.0	25	42	0.02	0.01	0.13	0.13	0.95	0.16	7.15	2.08	0.10
	MIN	7.9	19		0.4	11.0	11.5	6.8	3.0	10	27	0.02	0.01	0.03	0.01	0.37	0.05	0.10	0.04	0.06
											STATION 3									
7/9/68	1430	8.7	20	95	--	32.0	22.9	7.7	8.5	10	50	0.01	0.01	0.02	<0.01	0.38	0.11	2.48	1.50	0.05
7/10/68	1015	8.3	19	88	--	30.0	25.6	7.4	10.5	10	53	0.01	0.01	0.02	<0.01	0.48	0.29	0.22	0.13	0.12
7/11/68	1315	8.7	20	95	0.7	26.0	35.6	7.4	14.5	10	50	0.02	0.01	0.04	0.01	0.59	0.18	0.11	0.03	0.12
9/16/68	1405	9.2	22	104	--	26.0	31.0	7.5	5.0	20	60	0.01	--	0.09	0.08	0.26	0.19	0.14	0.03	0.01
7/9/70	0910	7.3	22	83	1.5	26.0	28.0	7.2	3.5	--	67	0.01	<0.01	0.07	0.02	0.50	0.16	0.24	0.18	0.03
	MEAN	8.4	21	93	1.1	28	28.6	7.4	8.4	12	56	0.01	0.01	0.05	0.03	0.44	0.19	0.64	0.37	0.06
	MAX	9.2	22		1.5	32.0	35.6	7.5	14.5	20	67	0.02	0.01	0.09	0.08	0.59	0.29	2.48	1.50	0.12
	MIN	7.3	19		0.7	26.0	22.9	7.2	3.5	10	50	0.01	<0.01	0.02	0.01	0.26	0.11	0.11	0.03	0.01
											STATION 4									
7/9/68	1005	8.9	20	97	--	38.0	30.6	7.8	13.5	20	62	0.02	--	0.03	0.02	0.50	0.14	0.34	0.23	0.19
7/10/68	1345	8.8	18	93	--	32.0	28.5	7.6	11.5	20	61	0.01	0.01	0.02	0.01	0.44	0.12	0.51	0.24	0.39
7/11/68	0930	8.2	19	87	0.9	38.0	30.0	7.2	36.0	20	62	0.04	0.01	0.02	0.02	1.16	0.13	1.40	0.37	0.25
9/16/68	1345	9.7	20	105	--	29.0	34.0	7.6	5.5	20	65	0.02	--	0.03	0.03	0.25	0.17	0.20	0.14	0.06
7/9/70	1120	8.0	21	89	1.1	29.0	30.0	7.3	4.5	--	72	0.02	<0.01	0.08	0.01	0.44	0.10	0.20	0.14	0.20
	MEAN	8.7	20	94	1.0	33.2	30.6	7.5	14.2	20	64	0.02	0.01	0.04	0.02	0.56	0.13	0.53	0.22	0.22
	MAX	9.7	21		1.1	38.0	34.0	7.8	36.0	20	72	0.04	0.01	0.08	0.03	1.16	0.17	1.40	0.37	0.39
	MIN	8.0	18		0.9	29.0	28.5	7.3	4.5	20	61	0.01	<0.01	0.02	0.01	0.25	0.10	0.20	0.14	0.06
											STATION 5									
7/9/68	1315	9.9	18	104	--	10.0	7.3	7.4	8.5	10	17	0.01	0.01	0.02	0.01	0.46	0.13	0.07	0.07	0.05
7/10/68	1115	9.3	18	98	--	12.0	7.8	7.2	8.5	10	17	0.01	0.01	0.02	0.01	0.36	0.14	1.23	0.88	0.04
7/11/68	1215	9.0	18	95	0.6	8.0	7.0	7.3	6.5	10	16	0.01	0.01	0.02	0.01	0.32	0.10	0.08	0.08	0.04
9/16/68	1220	9.6	18	101	--	7.0	13.0	7.4	5.5	15	22	0.02	0.02	0.03	0.03	0.25	0.10	0.11	0.04	0.03
7/9/70	1010	8.6	18	90	0.7	7.0	9.0	7.6	4.5	--	21	0.02	<0.01	0.05	<0.01	0.65	0.10	0.16	0.11	0.06
	MEAN	9.3	18	98	0.6	8.0	8.8	7.4	6.7	11	19	0.01	0.01	0.03	0.01	0.41	0.11	0.33	0.24	0.05
	MAX	9.9	18		0.7	12.0	13.0	7.6	8.5	15	22	0.02	0.02	0.05	0.03	0.65	0.14	1.23	0.88	0.06
	MIN	8.6	18		0.6	7.0	7.0	7.2	4.5	10	16	0.01	<0.01	0.02	<0.01	0.25	0.10	0.07	0.04	0.03

TABLE D-2 (Contd)
CARTERS DAM
SUMMER - 1968-1969-1970 - SURVEYS

Date	Time	DO mg/l	Water Temp °C	DO Sat %	BOD_5 mg/l	Tot Hardness mg/l as $CaCO_3$	Tot Alk mg/l as $CaCO_3$	pH	Turb JTU	Color Pt-Co. U	Conductivity µmho	Phosphate mg/l as P Total	Phosphate mg/l as P Dissolved	Manganese mg/l Total	Manganese mg/l Dissolved	Iron mg/l Total	Iron mg/l Dissolved	TKN mg/l	NH_3-N mg/l	NO_3+NO_2-N mg/l
										STATION 6										
9/16/68	1305	8.3	18	87	--	7.0	14.0	7.2	9.5	25	23	0.540	0.038	0.02	0.02	0.38	0.17	0.38	0.26	0.053
										STATION 6L										
7/9/68	1055	8.5	20	92	2.1	14.0	8.4	7.2	15.5	20	23	0.04	0.23	0.02	0.02	0.51	0.14	0.36	0.19	0.09
7/10/68	1300	8.3	18	87	--	10.0	9.3	7.0	48.0	20	25	0.06	0.02	0.04	0.02	1.00	0.17	1.42	0.36	0.09
7/11/68	1015	7.8	18	82	--	14.0	7.5	6.5	49.0	20	24	0.07	0.02	0.04	0.02	1.87	0.16	0.56	0.42	0.13
7/16/68	0937	6.6	23	76	--	7.5	8.5	7.1	7.5	--	26	0.03	0.02	0.19	0.03	0.56	0.14	1.20	0.52	0.08
7/9/70	1045	7.1	20	77	3.7	8.0	11.0	7.3	5.5	--	26	0.06	0.01	0.05	0.02	0.62	0.09	0.43	0.34	0.08
	MEAN	7.7	20	83	2.9	10.7	8.9	7.0	25.1	20	25	0.05	0.02	0.07	0.02	0.91	0.14	0.79	0.37	0.09
	MAX	8.5	23		3.7	14.0	11.0	7.3	49.0	20	26	0.07	0.02	0.19	0.03	1.87	0.17	1.42	0.52	0.13
	MIN	6.6	18		2.1	7.5	7.5	6.5	5.5	20	23	0.03	0.01	0.02	0.02	0.51	0.09	0.36	0.19	0.08
										STATION 6R										
7/9/68	1130	8.7	20	95	2.4	16.0	8.4	7.2	15.5	20	23	0.05	0.02	0.04	0.02	0.54	0.10	2.64	0.64	0.08
7/10/68	1245	8.2	18	86	--	10.0	8.5	7.0	48.0	20	24	0.06	0.02	0.06	0.04	1.20	0.04	1.59	1.26	0.08
7/11/68	1040	7.8	18	82	2.6	12.0	7.5	6.8	48.0	20	21	0.08	0.02	0.06	0.04	1.41	0.09	0.82	0.20	0.11
7/16/69	0945	6.6	23	76	--	8.0	8.0	7.1	11.5	--	26	0.04	0.04	0.29	0.03	0.62	0.15	1.03	0.34	0.08
7/9/70	1050	7.0	20	76	3.3	7.0	10.0	7.3	5.5	--	26	0.04	0.01	0.05	0.02	0.76	0.09	0.40	0.26	0.07
	MEAN	7.7	20	83	2.8	10.6	8.5	7.1	25.7	20	24	0.05	0.02	0.10	0.03	0.91	0.09	1.30	0.54	0.08
	MAX	8.7	23		3.3	16.0	10.0	7.3	48.0	20	26	0.08	0.04	0.29	0.04	1.41	0.15	2.64	1.26	0.11
	MIN	6.6	18		2.4	7.0	7.5	6.8	5.5	20	21	0.04	0.01	0.04	0.02	0.54	0.04	0.40	0.20	0.07
										STATION 7L										
7/9/68	1200	8.2	20	89	8.8	14.0	8.9	7.2	24	20	27	0.17	0.10	0.04	0.01	0.47	0.05	1.71	1.01	0.08
7/10/68	1140	8.3	18	87	--	10.0	9.3	7.0	36	20	32	0.25	0.10	0.04	0.01	0.83	0.05	1.64	0.97	0.07
7/11/68	1120	8.1	19	86	--	10.0	8.7	6.7	45	20	26	0.24	0.08	0.05	0.03	0.89	0.07	2.15	1.70	0.10
9/16/68	1245	9.5	18	100	--	8.0	13.0	7.2	9.5	25	21	0.08	0.05	<0.01	--	0.31	0.10	0.42	0.18	0.05
7/16/69	0920	7.5	23	86	--	9.0	7.5	7.1	14.5	--	28	0.29	0.19	0.12	0.03	0.45	0.10	2.18	1.07	0.08
7/9/70	1030	7.8	20	85	>8.4	8.0	10.0	7.2	8.5	--	48	0.14	0.06	0.06	0.01	0.56	0.09	1.00	0.61	0.08
	MEAN	8.2	20	89	>8.6	9.8	9.6	7.1	22.9	21	30	0.19	0.10	0.05	0.02	0.58	0.08	1.52	0.92	0.08
	MAX	9.5	23			14	13.0	7.2	45	25	48	0.29	0.19	0.12	0.03	0.89	0.10	2.19	1.70	0.10
	MIN	7.5	18			8	7.5	6.7	8.5	20	21	0.08	0.05	<0.01	0.01	0.31	0.05	0.42	0.18	0.05
										STATION 7R										
7/9/68	1235	8.6	20	94	0.8	10.0	8.4	7.3	24	20	22	0.04	0.02	0.04	0.01	0.70	0.10	1.96	1.70	0.08
7/10/68	1200	8.5	18	90	--	10.0	8.9	7.0	100	20	19	0.07	0.02	0.04	<0.01	2.54	0.07	0.45	0.33	0.08
7/11/68	1100	8.6	19	91	--	10.0	8.1	6.8	43	20	21	0.05	0.04	0.06	0.01	1.04	0.16	0.12	0.09	0.09
9/16/68	1245	9.3	19	99	--	8.0	11.0	7.4	9.5	25	24	0.04	0.03	0.01	0.02	0.38	0.17	0.10	0.03	0.05
7/16/69	0910	7.9	23	91	--	8.5	8.5	7.2	6.5	--	27	0.03	0.02	0.08	0.03	0.48	0.19	0.67	0.36	0.08
7/9/70	1025	7.5	20	82	2.2	7.0	10.0	7.2	5.5	--	27	0.02	0.01	0.11	0.02	0.45	0.10	0.25	0.11	0.09
	MEAN	8.4	20	91	1.5	8.9	9.2	7.1	31.4	21	23	0.04	0.02	0.06	0.02	0.93	0.13	0.59	0.44	0.08
	MAX	9.3	23		2.2	10	11	7.4	100	25	27	0.07	0.04	0.11	0.03	2.54	0.19	1.96	1.70	0.09
	MIN	7.5	18		0.8	7	8.4	6.8	5.5	20	19	0.02	0.01	0.01	<0.01	0.38	0.07	0.10	0.03	0.05

* Not included in average.

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TABLE D-3

CARTERS PREIMPOUNDMENT STUDY
BACTERIAL DATA

Total Coliform/100 ml

Station	4/4/68	4/5/68	4/8/68	4/9/68	4/10/68
1	3,200	40,000	1,500	900	1,900
2	3,500	40,000	1,900	300	1,500
3	490	10,900	850	100	280
4	1,200	22,000	1,800	100	720
5	730	32,000	1,200	100	1,200
6 Right	>50,000	40,000	15,000	2,000	11,800
6 Left	>50,000	30,000	19,000	2,500	11,800
7 Right	-	-	-	-	11,000
7 Left	-	-	-	-	110,000

Station	7/9/68	7/10/68	7/11/68	7/16/69
1	19,600	17,400	37,000	-
2	16,700	35,000	26,000	-
3	13,700	38,000	34,000	-
4	20,500	16,000	72,000	-
5	7,800	5,600	9,000	-
6 Right	62,000	120,000	120,000	50,000
6 Left	43,000	96,000	102,000	80,000
7 Right	55,000	46,000	94,000	39,000
7 Left	105,000	240,000	220,000	100,000

TABLE D-3 (cont'd)

CARTERS PREIMPOUNDMENT STUDY
BACTERIAL DATA

Fecal Coliform/100 ml

Station	4/4/68	4/5/68	4/8/68	4/9/68	4/10/68
1	-	5,900	160	220	230
2	-	5,000	100	50	230
3	-	4,000	80	50	60
4	-	4	300	70	100
5	-	10,200	230	20	170
6 Right	-	9,800	900	420	2,200
6 Left	-	10,200	1,200	700	2,200
7 Right	-	-	-	-	1,800
7 Left	-	-	-	-	19,000

Station	7/9/68	7/10/68	7/11/68	7/16/69
1	120	110	310	-
2	190	270	350	-
3	70	70	113	-
4	730	360	2,340	-
5	280	240	87	-
6 Right	5,500	11,000	11,000	25,000
6 Left	5,500	14,000	11,200	15,000
7 Right	5,800	7,200	16,000	6,200
7 Left	36,000	82,000	34,000	26,000

Table D-4 CARTERS DAM PREIMPOUNDMENT STUDY

Distribution and Relative Abundance of Invertebrates in Coosawattee River and tributaries, April 1968

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
TURBELLARIA								
Dugesia sp.				c				
ANNELIDA								
Limnodrilus sp.	c	c	c	c	c	a	d	c
Helobdella sp.							+	
CRUSTACEA								
Asellus sp.	+							
Lirceus sp.			+					
Synurella sp.								+
Procambarus spiculifer (Le Conte)				+			+	
Cambarus latimanus (Le Conte)	+		+					
HEMIPTERA								
Gerris sp.	c							

+ Present (1-5)* a Abundant (15-25)*

c Common (5-15)* d Predominant (>25)*

*Number of individuals per 30 minute search.

Table D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
ODONATA								
Argia moesta (Hagen)				c	c			
Argia putrida (Hagen)			c		c			
Agrion maculatum Beauvois						c		c
Gomphus amnicola Walsh					c			
Gomphus notatus Rambur					+			
Gomphus sp.					c			
Boyeria vinosa Say		c				c		c
Hagenius brevistylus Selys				+				
Lanthus albistylus Hagen				+				
EPHEMEROPTERA								
Ameletus lineatus Traver		+	+		+			
Isonychia pictipes Traver		c	a	a	a			
Baetis inercalaris McDunnough		c						
Baetis sp.	c	c	c			c		c
Pseudocloeon alachua Berner					c			
Pseudocloeon etowah Traver		c		c				c
Pseudocloeon punctiventris (McDunnough)	c		c					

Table D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
Epeorus (iron) sp.				a	a	a		c
Stenonema smithae Traver	c	c			c	c		
Stenonema sp.			c	c	c	c		c
Leptophlebia (Blasturus) intermedia (Traver)	+		+					
Ephemerella (Ephemerella) berneri Allen & Edmunds	+		+					
Ephemerella (Ephemerella) choctawhatchee Berner		+	+					
Ephemerella (Eurylophella) trilineata Berner			c	+	+	+		c
Ephemerella (Serratella) de ficens Morgan		+						
Ephemerella (Serratella) serratoides McDunnough	c							
Ephemerella sp.[1]	+	+	+	+	+	+		
Ephemerella sp.[2]			+	+			+	+
Ephemerella sp.[3]	+		+	+	+	a	a	+
Caenis hilaris (Say)	c							
Neoephemera purpurea (Traver)								+
Baetisca carolina Traver				+				
Ephemera simulans Walker				+				

Table D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
PLECOPTERA								
Pteronarcys sp.					+			
Pteronarcella sp.						+		+
Peltoperla sp.		c	c		c	c		
Nemoura sp.	c	c	c		c	c		c
Leuctra sp.		+				+		
Perlesta placida (Hagen)	+		c	c		+		+
Acroneuria sp. 1			c	c	c			
Acroneuria sp. 2				c				
Acroneuria sp. 3					c			
Phasganophora capitata (Pictet)			+	+				
Isogenus sp.			c	c				
Isoperla sp. 1	+		+	+		+		+
Isoperla sp. 2	+	+	c	+		+		+
Isoperla sp. 3	+	+						
Alloperla sp.			+					
MEGALOPTERA								
Corydalus cornutus Latreille		c	a	a	a	c		

TABLE D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
TRICHOPTERA								
Rhyacophila fuscula (Walker)				+	+			
Trentonius distinctus (Walker)					+			
Dolophilus sp.					+			
Chimarra sp.				c		+		
Polycentropus sp.					+			
Psychomyiid Genus A Ross			+		+			
Smicridea sp.					+			
Hydropsyche sp.	c	c	a	a	a	c		c
Cheumatopsyche sp.	c	c	a	a	a	c		c
Agraylea sp.			+					
Pycnopsyche sp.	+	+	+	+			+	
Caborius sp.			+					
Neophylax sp.								+
Leptoceridae (prob. Leptocella)			+					
Oecetis cinerascens (Hagen)	+							
Oectis sp.			+					
Lepidostoma sp.		+	+					
Brachycentrus sp.			+					

Table D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
DIPTERA								
Tipula (Nippotipula) abdominalis (Say)		+		c	c	c		
Tipula sp.				c		c		
Protoplasa fitchii Osten Sacken						+		
Palpomyia libialis (Meigen)				+				
Palpomyia sp.				+				
Ablabesmyia basalis (Walley)		+			+			
Ablabesmyia mallochi (Walley)				c				
Ablabesmyia sp.						c		
Diamesa sp.		+						
Brillia sp.								+
Nanocladius (Eukiefferiella) sp. I (Roback)					+			
Nanocladius sp.				+				
Orthocladius sp.	c	c				c	c	c
Cricotopus bicinctus (Meigen)			c	c	c	c		c
Crictopus sp.		c		c	c	c		c
Trichocladius robacki (Malloch)	+	+						
Trichocladius sp.	c	c	c	c	c	c		c

Table D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
Corynoneura (Thienemanniella) sp.				+				
Chironomus (Cryptochironomus) digitatus Malloch				+				
Chironomus (Cryptochironomus) sp.					+	+		
Chironomus (Endochironomus) nigricans Johannsen			a	a	a	c	a	
Chironomus (Tribelos) jucundus Walker				c	c			
Chironomus (Tribelos) sp.			+	+				
Glyptotendipes (Glyptotendipes) senilis (Johannsen)						+		
Polypedilum fallax (Jchannsen)		c	c	c	c	a	+	
Polypedilum halterale (Coquillett)			+		+			
Polypedilum illinoense (Malloch)		c	a	a	a	c	+	c
Polypedilum scalaenum (Schrank)				c	c	a	a	
Stenochironomus hilaris (Walker)			+					+
Tanytarsus sp. B Beck			+		+			+
Tanytarsus sp.					+	+		+
Rheotanytarsus exiguus Johannsen			c		c			c
Simulium sp.		c	c	c				c
Atherix variegata Walker					+			

Table D-4 (contd.)

ORGANISMS	STATIONS							
	1	2	3	4	5	6	7L	7R
COLEOPTERA								
Copelatus sp.			+					
Dineutus (Cyclinus) discolor Aube'		+						+
Dineutus sp.	+	+						
Gyrinus pachysomus Fall	+							+
Dryops sp.				+				
Stenelmis sp.	+		c					
Macronychus glabratus Say	c		c	c	c			
Ancyronyx variegatus (Germar)			c			c		c
Psephenus herricki			c	c	c			
Mollusca								
Viviparus sp.				c	c			
Goniobasis curvicostata Reeve				a	a			
Goniobasis sp.				a	a			
Physa crecata Lea				+				
Ferrissia sp.	c	c						
Sphaerium stamineum Conrad					c			
TOTALS Biotic Index	18	21	43	41	44	27	2	24
Species	30	34	52	55	52	36	12	34

APPENDIX E

PROJECT PERSONNEL

PROJECT PERSONNEL

Bobby J. Carroll	-	Microbiologist
Ralph E. Gentry	-	Microbiologist
Steve Hall	-	Sanitary Engineer
John A. Little	-	Sanitary Engineer
Robert F. Schneider	-	Aquatic Biologist
Hugh C. Vick	-	Physical Science Technician
M. Ron Weldon	-	Biological Technician
Raymond T. Wilkerson	-	Hydraulic Engineering Technician